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EPA Superfund
Record of Decision:

BUSH VALLEY LANDFILL
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Text:

RECORD OF DECISION

BUSH VALLEY LANDFILL
SUPERFUND SITE

PREPARED BY
THE U.S. ENVIRONMENTAL
PROTECTION AGENCY

SEPTEMBER 1995

RECORD OF DECISION
BUSH VALLEY LANDFILL SUPERFUND SITE

PART I - DECLARATION

I. Site Name and Location

Bush Valley Landfill Superfund Site
Harford County, Maryland

II. Statement of Basis and Purpose

This Record of Decision ("ROD") presents the final remedial action selected for the Bush Valley Landfill Superfund Site ("Site"), located near the town of Abingdon in Harford County, Maryland. This remedial action was chosen in accordance with the requirements of the Comprehensive Environmental Response Compensation and Liability Act of 1980 ("CERCLA"), 42 U.S.C. §§9601 et. seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 ("SARA"), and the National Oil and Hazardous Substances Pollution Contingency Plan ("NCP"), 40 C.F.R. Part 300. This decision document explains the factual and legal basis for selecting the remedial action. The information supporting this decision is contained in the Administrative Record file for this Site.

The Maryland Department of the Environment ("MDE") has provided letters to the U.S. Environmental Protection Agency ("EPA") indicating their concurrence with the selected remedy.

III. Assessment of the Site

Pursuant to duly delegated authority, I hereby determine, pursuant to Section 106 of CERCLA, 42 U.S.C. § 9606, that actual and threatened releases of hazardous substances from this Site, as discussed in Part II, Sections VI and VII (Summary of Human Health Risks and Summary of Environmental Risks) of this ROD, if not addressed by implementing the remedial action selected in this ROD, may present an imminent and substantial endangerment to human health or the environment.

IV. Description of the Selected Remedy

This Site is a former municipal landfill comprising approximately 16 acres. The remedial action selected for this Site is a final remedy which will address the wastes buried in the landfill, contaminated soils, leachate, landfill gas, the adjacent wetlands and streams, and contaminated ground water. The selected remedy includes a combination of containment measures and engineering controls in accordance with the EPA directive, Presumptive Remedy for CERCLA Municipal Landfill Sites, September 1993 (OSWER Directive 9355.0-49), which establishes containment as the presumptive remedy for CERCLA municipal landfills.

The selected remedy includes the following major components:

! A single barrier cover system over the landfill;

! A landfill gas management system;

! A monitoring system for adjacent wetlands, streams and ground water; and

! Land-use and access restrictions.

V. Statutory Determinations

This selected remedy is protective of human health and the environment, complies with federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective.

Because this remedial action will result in hazardous substances remaining onsite, a review by EPA will be conducted within five years after initiation of remedial action, and every five years thereafter, as required by Section 121(c) of CERCLA, to ensure that the remedy continues to provide adequate protection of human health and the environment.

<IMG SRC 0395198>

Thomas C. Voltaggio, Diretor	Date

Hazardous Waste Magement Division
EPA Region III

RECORD OF DECISION
BUSH VALLEY LANDFILL SITE

DECISION SUMMARY
TABLE OF CONTENTS

APPENDIX I - FIGURES

APPENDIX II - TABLES

PART II - DECISION SUMMARY
BUSH VALLEY LANDFILL SUPERFUND SITE

I. Site Name, Location, and Description

The Bush Valley Landfill Site ("Site" or "landfill") is located in the northeastern portion of Harford County, Maryland, approximately 20 miles northeast of Baltimore and 8 miles northwest of the Chesapeake Bay. The Site is south of Route 7 just off of Bush Road. Abingdon is the closest town to the Site and is about one mile to the southwest (see Figure 1).

The landfill, as permitted in 1975 by the State of Maryland, Department of Health and Mental Hygiene ("DHMH"), was 29 acres in size. The area where landfilling operations actually took place consists of a rectangular shaped mound approximately 600 feet by 1200 feet within the 29-acre parcel (see Figure 2). The landfill was designed as a trench and fill operation. Landfill design drawings indicate that there were ten trenches covering approximately 16 acres oriented east to west approximately 50 feet wide and up to 25 feet deep, separated by a 5 foot buffer strip. The landfill reaches an approximate height of 20 to 25 feet above the surrounding terrain and is estimated to extend 25 feet below ground surface. Although initially designed as a trench and fill operation; once the trenches were full wastes were apparently piled on top of the trenches. This would account for the elevation of the landfill above ground surface. Design drawings of the trenches illustrate a bottom elevation that is within approximately 5 feet of the water table.

In general, the area surrounding the Site is residential, with some wooded areas. To the north and east of the Site lies a tidal freshwater marsh zone. This marsh zone is part of the Bush Declaration Natural Resource Management Area ("BDNRMA"). The BDNRMA is approximately 120 acres in size; development and use of the area is restricted. In 1985, the State of Maryland, Department of Natural Resources ("DNR") purchased a 12-acre parcel of land which was part of the original 29-acre permitted landfill site. The 12-acre parcel of land purchased by DNR was annexed as part of the BDNRMA. Bynum Run Creek, a perennial stream, flows around the north side of the landfill in a northeastwardly direction until it converges with James Run, which flows into a Bush River Tributary. The confluence of the Bynum Run Creek and James Run/Bush River Tributary is approximately 800 feet northeast of the Site. Another tributary to the Bush River originates within a few hundred feet of the southeastern portion of the landfill (see Figure 2).

The area west, south, and north of the Site is primarily residential. Recent housing development in the vicinity of the Site includes the new Harford Town Community (formerly known as the Hidden Stream Development). This community is located less than one quarter mile west of the Site and will consist of approximately 169 townhomes, 456 condominium units, and 57 individual homes when completed. The Beachwood Mobile Home Park is located approximately 800 feet to the south of the Site.

In December 1989, a municipal water line was completed for Harford County residents. Every residence located along Bush Road, including the mobile home park and those residences closest to the landfill, are currently using public water for drinking. Any new housing in the area is required to connect to the public water system. Domestic wells are still active at a few residences in the vicinity of the Site; however, the water from these wells is not used for drinking. Other land parcels in the County have been identified as having wells onsite; however, each of these wells is a significant distance from the Site and/or is hydrogeologically upgradient or isolated from the Site.

At this time, there is no evidence of the existence of any endangered or threatened species at the Site. There is also no evidence of significant scientific, historical, or archaeological resources at or impacted by the Site. Finally, there are no properties included in or eligible for the National Register of Historic Places and no National Historic Landmarks at or impacted by the Site.

II. Site History and Enforcememt Activities

The Bush Valley Landfill property has been owned by the Harris and Braxton families for many years. Three generations ago, the Harris and Braxton families used the land for grazing cattle and raising crops. At one point, Lloyd Harris, Sr. and his son, Lloyd Harris, Jr., started a trash hauling business which they owned and operated for a number of years. In 1974, in order to expand their business to include landfilling of solid waste, Lloyd Harris, Sr. and Lloyd Harris, Jr. leased the property which was to become the Bush Valley landfill from Charlotte Harris, Evelyn Braxton Peaker, and Allen and Martha Braxton. In 1975, Lloyd Harris submitted a site plan, procedures of operation, and a permit application to the State of Maryland, DHMH. On February 21, 1975, Harford County ("the County") entered into an agreement with Bush Valley Landfill, Inc., Lloyd Harris, James R. Harris, and Roger E. Harris to operate a sanitary landfill for wastes generated in the county. The County paid the landfill operators based on the weight of wastes disposed of at the landfill; this initial agreement between the County and the operators was extended on July 25, 1980, for the life of the landfill. On August 25, 1975, DHMH permitted the Site for use and operation as a municipal solid waste landfill, Permit No. 75-12-01-02A. Based on information gained during interviews with people living in the vicinity of the Site, EPA believes that Lloyd Harris began depositing waste at the Site sometime during 1974 or early 1975, before the permit was issued.

Although the trench system of landfilling was used at the Site, as discussed above, both DHMH and Harford County Health Department ("HCHD") inspection reports indicate that the operators of the landfill did not adhere to the site plan or the operation procedures outlined in the permit. Bush Valley Landfill, Inc. and Lloyd Harris were cited for, among other things, improper sloping of the trenches, refuse overflow from one trench to another, water accumulation in the trenches, and lack of daily soil cover. In addition, Lloyd Harris may have accepted hazardous waste at the landfill. Furthermore, there are reports of drums being disposed of at the landfill. Finally, on numerous mornings, wastes were found on top of the daily soil cover that had been applied the previous day, indicating that "midnight dumping" had occurred.

On October 20, 1978, DHMH ordered Lloyd Harris and Bush Valley Landfill, Inc. to undertake a series of actions to correct operational and design deficiencies which caused violations of State law. Bush Valley Landfill, Inc. and Lloyd Harris failed to comply with the order, and on May 6, 1979, DHKH ordered them to hire a competent organization to take charge of the landfill to assure that certain corrective measures were undertaken. Bush Valley Landfill, Inc. and the Maryland Environmental Services ("MES") entered into a contract whereby MES was to supervise operations at the landfill. An MES employee remained at the Site on a daily basis for most of the following year. This did not result in the correction of the deficiencies noted in the previous violations. Thus, on May 2, 1980, DHMH again ordered Bush Valley Landfill, Inc. and Lloyd Harris to undertake the requisite corrective action to address the design and operational deficiencies that were causing violations of Maryland law. Bush Valley Landfill, Inc. and Lloyd Harris never brought the landfill into compliance.

As of December 3, 1982, Lloyd Harris and Bush Valley Landfill, Inc. were still accepting solid waste at the landfill. Shortly thereafter, the landfill was filled to capacity and Lloyd Harris and Bush Valley Landfill, Inc. ceased to maintain the Site. The Site received minimal cover material when landfill operations were discontinued. A review of Maryland Department of the Environment ("MDE") records from the time period between 1983

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1 Information regarding the potential for the presence of hazardous waste in the landfill, drums being disposed of in the landfill, and the occurrence of midnight dumping was obtained from interviews with people living in the vicinity of the Site.

to 1985 revealed that stabilization of the landfill was inadequate and that erosion of the cover had exposed refuse in some areas. There was insufficient maintenance of the northeast sedimentation basin; during inspections, leachate seeps were observed at numerous locations. The majority of leachate seeps were located on the top of the northern and northeastern portion of the landfill mound.

In 1983, MDE conducted a Site visit at the landfill for purposes of preparing a preliminary assessment ("PA") report. This PA was submitted to EPA in August 1984. In 1984, NUS Corporation (an EPA contractor) collected samples during a Site Investigation ("SI") and prepared an SI report. EPA then prepared a Hazard Ranking System ("HRS") score to determine the Site's eligibility for inclusion on the National Priorities List ("NPL"). The score for the Site was 40.29; sites which score greater than 28.5 are eligible for inclusion on the NPL. In June of 1988, the Site was placed on the NPL.

The Site was assigned to MDE as a state lead response action under a cooperative agreement in January 1989. A Remedial Investigation/Feasibility Study ("RI/FS") work plan was subsequently developed under MDE's supervision. The purpose of the RI/FS was to identify the nature and extent of contamination and to develop and evaluate remedial alternatives to address such contamination. At this point, Harford County opted to take a more active role in the development of the RI/FS and, as a result, in June 1990, the County began to negotiate an Administrative Order on Consent ("AOC") with EPA under which the County would conduct the RI/FS at the Site. The AOC between the County and EPA became effective on December 21, 1990.

The County conducted the RI sampling program under the AOC from January 1991 through May 1993 and the RI report was accepted as final by EPA on March 7, 1995. The County submitted its initial draft FS on February 24, 1995. The revised FS, submitted on May 25, 1995, was found to be inadequate by EPA. The FS was revised by EPA and considered final on June 8, 1995.

For a detailed chronology of events at the Site, see Table 2-1 of the Remedial Investigation Report ("RI") which is part of the Administrative Record.2

2 The Administrative Record file contains all of the Site information that was considered or relied upon in selecting the remedy. The Administrative Record is located in a repository at the EPA Region III Office in Philadelphia. A copy has also been placed at the Harford County Library in Bel Air, Maryland.

III. Highlights of Community Participation

The RI/FS Report and the Proposed Remedial Action Plan ("PRAP") for the Bush Valley Landfill Site were released to the public for comment on June 15, 1995, in accordance with the requirements of Sections 113(k), 117(a), and 121(f) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended ("CERCLA" or "Superfund"), 42 U.S.C. Sections 9613(k), 9617(a), and 9621(f). These documents were made available to the public in the Administrative Record at both an information repository maintained at the EPA Docket Room in Region III, Philadelphia and the Bel Air Branch of the Harford County Library in Bel Air, Maryland. Notices of availability for these documents were published in two newspapers of general circulation in Herford County: in The Record on June 14, 1995 and in The Aegis on June 16, 1995. The public comment period for the PRAP opened on June 15, 1995 and extended to July 14, 1995.

In addition, a public meeting was held by EPA on June 26, 1995, at the Edgewood High School in Edgewood, Maryland, in accordance with Section 117(a)(2) of CERCLA, 42 U.S.C. Section 9617(a) (2). At this meeting, representatives from EPA presented the findings of the RI/FS and answered questions about the Site and the remedial alternatives that were being considered at that time.

Following the public meeting and the close of the comment period, EPA evaluated and considered comments received from the public, including comments from MDE. Responses to all significant comments, including those expressed verbally at the public meeting, are included in the Responsiveness Summary, which is part of this Record of Decision ("ROD").

IV. Scope and Role of Response Action

The selected alternative will address all areas and media impacted by the contamination at the Site, including the landfill itself, contaminated soils, contaminated ground water, landfill gas, and the wetlands and streams adjacent to the Site. EPA anticipates that this response action will adequately address all contaminated areas of the Site; however, there is a potential for subsequent actions regarding the ground water, landfill gas emissions, and the wetland and streams. The necessity of any subsequent response actions will depend on information obtained during long-term monitoring associated with the selected remedy. EPA has determined that addressing the Site as separate operable units for individual media is presently not warranted.

V. Summary of Site Characteristics

A. General

The RI field activities and analytical program were designed to define the extent of contamination in the landfill itself, the soils, the ground water, surface water and sediments, leachate, and adjacent wetlands, as well as to identify migration pathways and provide data to support a feasibility study ("FS") of potential remedial actions. The following activities were completed at the Site during the RI:

- Site Reconnaissance;
- Geophysical Surveying;
- Geological Investigations;
- Ground Water Monitoring Well Installation;
- Surveying and Water Level Measurements;
- Human Population and Land Use Investigations;
- Ecological Investigations; and
- Sampling of Various Media.

B. Site Geology

The Site falls in the physiographic province of the Coastal Plain Sediments. The Site is underlain by two distinct sand layers separated by finer textured materials. The upper sand zone is encountered approximately five to twenty feet below ground surface and varies in thickness from two to ten feet. The upper sand zone does not exist or becomes non-distinct to the east of the Site. The thickness and physical characteristics of the upper sand zone vary between locations, suggesting the possibility that the upper sand zone may not be continuous between locations. It is likely that the upper sand zone is intermittently or seasonally saturated at some locations. Based on the information collected during the RI, the upper sand zone may not contribute significantly to the ground water flow characteristics of the Site.

The upper and lower sand zones are separated by a layer of finer grained material that is variable in thickness and texture. The separation layer was observed to range from 10 to 15 feet in thickness. The fine-grained material separating the upper and lower sand zones is dominated by clay and silt, and the sand fraction tends to increase with depth as the lower sand zone is approached.

The second or lower sand zone is encountered approximately 35 feet below ground surface on the west side of the Site and less than 20 feet below ground surface on the east side of the Site. The thickness of the lower sand unit was observed to be at least 20 to 30 feet. The lower sand zone is considered the uppermost continuous water-bearing unit in the vicinity of the Site. Ground water elevations collected indicate that the primary direction of ground water flow is from west to east across the Site to the tidal marsh and the unnamed tributary of the Bush River which serve as discharge locations for ground water. The ground water flow rate from west to east across the Site within the lower sand zone is estimated to range from 0.0026 to 2.6 feet per day.

The RI information collected indicates that Bynum Run Creek is also a discharge location for ground water flowing beneath the Site. Water elevations measured in the lower sand zone across the Site indicate that ground water beneath the Site has both lateral and upward components of flow. Therefore, Bynum Run Creek and the tidal marsh are supported by the ground water table characterized in the lower sand zone. The unnamed tributary to the Bush River is believed to be a discharge area. This tributary originates a few hundred feet east of the Site. It is therefore assumed that ground water discharge from the lower sand zone occurs in the tidal marsh within a few hundred feet of the Site.

C. Landfill Characteristics

The Bush Valley Landfill is comprised of solid waste that has been exposed to precipitation. As a result, leachate has developed. The solid waste and the resultant leachate are the primary sources of contamination at the Site.

The quality of leachate from most landfills is highly variable and depends on the waste composition, depth of fill, type of cover material, operation of the landfill site, climate, and hydrogeology of the site. The process of leachate generation at the Site is dependent on a number of factors; however, precipitation events play a major role. Precipitation reaching the landfill surface can either evaporate, transpire, infiltrate through the landfill surface, or become surface runoff. When a sufficient amount of water infiltrates the landfill and comes in contact with the waste, leachate generation can occur. The volume of leachate generated and the extent of migration from the landfill depends on such factors as landfill surface conditions, volume of water percolation through the cells, refuse conditions, and underlying soil conditions. The relatively permeable surface and subsurface textures observed across the Site during field investigations suggest that precipitation can infiltrate and leachate can migrate through the soils at the surface and beneath the landfill cell; however, ponding of leachate within the cell could also occur.

Leachate generation occurs as the various waste constituents are decomposed or stabilized by aerobic and anaerobic microorganisms and converted to gasses and soluble organic and inorganic compounds. The initial leaching includes the dissolution of soluble material in the landfill such as salts and organic material. These dissolved constituents usually impart a brown/black color to the leachate. Biological activity within the cells will initially produce more soluble end products such as simple organic acids and alcohols. These products may undergo further biochemical reactions to release gaseous end products (e.g., carbon dioxide and methane); however, some of the soluble organic material may be leached out of the cell. In addition, organic nitrogen is converted to ammonium ions, which are readily soluble and can give rise to significant quantities of ammonia in the leachate.

The nature and extent of contamination at the Site is discussed below and is organized by medium in the following sequence: Leachate; Subsurface Soil; Ground Water; Surface Soil; Surface Water and Sediment; and Ambient Air.

D. Sampling Results

1. Leachate

Six leachate samples were collected in March 1993 from locations at the Site. Leachate seeps, present on the top of the northern and northeastern portion of the landfill mound, were found to contain elevated levels of several organic compounds and metals. Samples from the leachate seeps contained toluene; 1,4-dichlorobenzene; 1,2-dichlorobenzene; 4-methylphenol; 2,4-dimethylphenol; naphthalene; 2-methylnaphthalene; and diethylphthalate at concentrations ranging from 2 micrograms per liter ("ug/l") to 9 ug/l. Based on the lowest observed effect levels, these organics are typically not considered toxic to aquatic life until the levels are in the milligram per liter ("mg/l") range. Gamma-BHC and Heptachlor were also detected in leachate samples at trace levels.

Numerous inorganic constituents were detected in leachate samples including aluminum, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, silver, sodium, vanadium, and zinc. A number of these inorganics provide a potential for adverse ecological effects. See Table 1 for a summary of contaminants found in leachate.

2. Subsurface Soils

A total of twelve subsurface soil samples were collected in June and July 1992, from various depth intervals ranging from 7 to 40 feet below ground surface. Four of the twelve samples were obtained from locations that are upgradient of the landfill. Both organic and inorganic constituents were detected in subsurface soils.

Total Volatile Organic Compounds ("VOCs") ranged from non-detect (at 6 of 12 locations) to 576 ug/Kg. Comparable levels of VOCs were detected in the upgradient and downgradient subsurface soil sampling locations, with the exception of the deep soil sample obtained from monitoring well GM2LSD, which is located on the south side of the landfill. This sample contained 576 ug/Kg total VOCs and was found in an area where elevated levels of voc's were also found in the ground water.

Twenty-two inorganic contaminants were detected in the subsurface soils. For the most part, levels of inorganic contaminants in subsurface soils are uniform throughout the Site. See Table 2 for a summary of contaminants found in sub-surface soils.

3. Ground Water

The following discussion focuses on maximum constituent concentrations detected in ground water samples collected among three sampling events performed in August 1992, October 1992, and March 1993. All ground water samples were analyzed for both organic and inorganic constituents. For inorganic contaminants, both total and dissolved inorganic analyses were conducted. In most cases, dissolved inorganic constituent concentrations were lower than total inorganic constituents. For all monitoring well samples, the following discussions are specific to dissolved inorganic constituents. For the domestic wells samples, total inorganics are also discussed.

An examination of ground water data showed two potential concentrated areas of contaminants. For risk assessment purposes, the two different areas (designated Area 1 & Area 2) were evaluated separately. While VOCs were detected throughout the Site, the center of this plume appears to be in the vicinity of monitoring wells 2, 3, and 4, which are located to the south and east of the site. These wells make up ground water Area 1. On the north side of the landfill, the concentrations of organics were lower, but concentrations of metals in ground water were higher. Therefore, monitoring wells 5, 6, and 8 comprise ground water Area 2. See Figure 3 for monitoring well locations.

a. Upgradient Ground Water Samples

A total of four upgradient ground water monitoring wells are present at the Site; these wells represent conditions in both the upper and lower water-bearing zones. Each of these wells were sampled during the two rounds of ground water sampling conducted during the RI (August and October 1992). The upper water-bearing zone at the Site is a perched sand layer, and the lower water-bearing zone is considered to be the uppermost continuous water-bearing unit.

Six organic contaminants were detected in upgradient ground water samples. Maximum Contaminant Level ("MCL") exceedances were detected in three of the four upgradient locations for trichloroethene ("TCE") and in one of the four upgradient locations for tetrachloroethene ("PCE"). Only one of the four upgradient monitoring wells is in the upper water-bearing zone (GM1US). The highest levels of TOE and POE were detected in this well. The MCL exceedances found in the upgradient ground water monitoring well locations suggest that these locations have been affected either by the Site or, potentially, another contamination source. It is possible that the Site is the source of the TCE and PCE found in the upgradient monitoring wells due to the following factors: (1) the volatile nature of the contaminants (VOCs); (2) the close proximity of the monitoring wells in question to the landfill; and/or (3) the potential for slight variations to the directional flow of the ground water. It should be noted that the concentrations of TCE and

PCE detected in several downgradient monitoring wells were considerably higher than the levels detected in the upgradient monitoring wells.

Thirteen dissolved inorganics were detected in upgradient ground water samples. Similar to the organics contamination discussed above, the highest levels of inorganics were detected in the monitoring well in the upper water-bearing zone. Nickel was detected in two upgradient monitoring wells above the MCL and cadmium was detected in one of these upgradient monitoring wells above the MCL. However, unlike the organics contamination, no inorganics exceeded MCLs in any of the downgradient monitoring wells. There is no clear pattern to the levels of inorganics and it is not evident that they are Site-related. See Table 3 for a summary of contaminants found in upgradient ground water samples.

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3 Maximum contaminant levels are contaminant-specific drinking water standards established under the Federal Safe Drinking Water Act and applicable to certain public water suppliers.

b. Downgradient Ground Water Samples

Seven downgradient onsite ground water samples were collected from the lower water-bearing zone at the Site during each round of ground water sampling. Ground water samples were collected from each of the onsite monitoring wells in August and October 1992. Ground water samples were also collected from monitoring wells GM2-LSS, GM3, and GM4-LSS in March 1993 (see Figure 3 for locations of all monitoring wells).

Twelve organic constituents were detected in downgradient onsite samples. Benzene; 1,2-dichloroethane; 1,2-dichloropropane; tetrachloroethane; trichloroethene; and vinyl chloride were detected in concentrations exceeding MCLs (see Table 4). The maximum concentrations for most of the twelve organic constituents detected in onsite ground water samples also exceeded the maximum concentrations detected upgradient sampling locations.

Fourteen dissolved inorganic constituents were detected in downgradient onsite ground water samples. As mentioned above, nickel was detected in two upgradient monitoring wells (GM1LSS and GM1US) above the MCL and cadmium was detected in one of these upgradient monitoring wells (GM1LSS) above the MCL. No inorganics exceeded MCLs in any of the downgradient onsite monitoring wells. For the most part, levels of inorganics in the onsite samples were comparable to the levels of inorganics in the upgradient samples. There is no clear pattern to the levels of inorganics and it is not evident that they are Site-related. Table 5 provides a summary of both organic and inorganic constituents detected in downgradient ground water wells.

TABLE 4

MCL EXCEEDANCES FOR ORGANICS IN GROUND WATER

CONTAMINANT:	MCL (ug/1)	GROUND WATER (ug/1)
Benzene	5	75
1,2-Dichloroethane	5	1404
1,2-Dichloropropane	5	14
Trichloroethene	5	52
Tetrachloroethene	5	56
Vinyl Chloride	2	13

4 The level shown in Table 4 represents the highest detected concentration.

5 The detected concentration was accompanied by the "J" qualifier, which means the associated positive value is an estimated quantity.

c. Domestic Ground Water Samples

Ground water samples were collected in August and October 1992 from three residential wells (depicted on Figure 2 as numbers 1, 2, & 3) which are adjacent to the southern portion of the Site.

Residential well #1 is located approximately 650-feet to the southwest of the Site in an upgradient position. One organic constituent, alpha-BHC, was detected in this well at 0.004 ug/l, which is the same concentration detected in other upgradient wells. Nine inorganic constituents were detected in this well. None of the concentrations of these nine constituents exceeded either MCLs or other inorganic concentrations at other upgradient locations. This domestic well is a hand-dug well that has been out of service for several years. See Table 6 for a summary of sampling results from this well.

Residential well #2 is located approximately 300-feet south of the Site in a lateral hydraulic position. No organic constituents were detected in this well. Twelve inorganic constituents were detected in this well, none of which exceeded any MCL's. See Table 7 for a summary of sampling results from this well.

Residential well #3 is located approximately 150-feet south of the Site in a lateral hydraulic position. No organic constituents were detected in this well. Eleven inorganic constituents were detected. None of the constituent concentrations in this well exceeded MCL's or upgradient constituent concentrations, with the exception of mercury. Mercury was detected in the this well during the October 1992 sampling event at 0.00034 mg/l, which is well below the MCL for mercury. Mercury was not detected during the August 1992 sampling event or in any of the other ground water samples during the October 1992 sampling event. As a result, the detection of mercury in this well is suspect. See Table 8 for a summary of sampling results from this well.

4. Surface Soil

A total of eight surface soil samples were collected from 0 to 0.5 feet below ground surface at the Site in August 1992. These surface soil samples included three upgradient samples collected from borings located across Bynum Run Creek and Bush Road.

The only VOC detected was acetone. Five semi-volatile constituents were detected in surface soil samples. In general, the semi-volatile concentrations in onsite samples are comparable to the levels found in background samples. There were slightly elevated levels of fluoranthene and pyrene, 54 ug/Kg and 57 ug/Kg respectively, in boring SUS6, which is located on the western portion of the Site directly on the landfill. Also, some relatively high levels of bis(2-ethylhexyl)phthalate were detected in borings SUS7 and SUS7DUP, 6100 mg/Kg and 2300 mg/Kg respectively. However, this contaminant is a common laboratory contaminant and may not be Site-related.

Fourteen inorganic constituents were detected in surface soil samples, the most noteworthy being mercury (0.25 ug/Kg at Sus7). In general, the levels of inorganic constituents in onsite samples were comparable to the levels of inorganic constituents found in the background samples. In many instances, the background concentrations were higher than the onsite concentrations. However, at sampling location SUS7, which is located in the northeastern portion of the Site, levels of barium, chromium, and manganese were detected at levels above background levels. See Table 9 for a summary of constituents found in surface soil samples.

5. Surface Water and Sediment

Surface water and sediment samples were collected from the onsite sedimentation basins, the drainage ditch, Bynum Run Creek, the Bush River Tributary, James Run, and the Unnamed Tributary. Sediment samples only were obtained from the marsh. Surface water was not identified as a medium of concern in either the baseline or the ecological risk assessment. Unless otherwise specified, the ecological guidelines for sediments referred to in the text below are Effects, Range Low ("ER-L") and Effects-Range Median ("ER-M") values. These values are guidance values developed by the National Oceanic and Atmospheric Administration ("NOAA"). These values are not independently enforceable and are used only for purposes of screening sediment quality.

a. Sedimentation Basin

Both surface water and sediment samples were obtained from each of the two sedimentation basins. The only organic contaminant detected in the surface water was carbon disulfide. A number of inorganics were detected in the surface water samples. Aluminum and iron were detected at levels above Federal Ambient Water Quality Criteria ("AWQC"). Lead was detected at 0.0035 mg/l in one of the surface water samples; this level is slightly above the Maryland Chronic Toxic Substances Criteria ("MCTSC"), which is 0.0032 mg/l. See Table 10 for a summary of constituents found in sedimentation basin surface water samples.

One semi-volatile constituent, bis(2ethyl-hexyl)phthlate, and no VOCs were detected in the sediment samples from the sedimentation basins. Several inorganic constituents were detected in the sediment samples. None of the levels of inorganics exceeded available ecological guidelines (ER-L and ER-M values). Although there are no "background" sedimentation basin samples per se to compare with, aluminum and iron appear to be present at elevated levels, 12,900 mg/Kg and 23,700 mg/Kg respectively. It should be noted that aluminum and iron are common at rather high levels in both soils and sediments in this area. See Table 11 for a summary of constituents found in sedimentation basin sediment samples.

b. Drainage Ditch

A surface water and a sediment sample were obtained from the drainage ditch on the northern side of the landfill. Organic constituents were not detected in either the surface water or the sediment sample from the ditch. Both sediment and surface water samples from the ditch generally contained inorganic constituents above those observed in background stream samples. Aluminum and iron were detected in the surface water sample at 0.232 mg/L and 1.43 mg/L respectively, which are above the AWQC6. Lead was detected in the surface water sample from the ditch at 0.0082 mg/L which is higher than the MCTSC (0.0032 mg/L). The results discussed above are for total inorganics. The dissolved organic analytical results indicated that no available criteria were exceeded. See Table 12 for a summary of constituents found in the surface water sample from the drainage ditch.

Several inorganic constituents were detected in the sediment sample from the drainage ditch; however, none of these exceeded available ecological criteria (ER-L or ER-M values). See Table 13 for a summary of constituents found in the sediment sample from the drainage ditch.

c. Bynum Run Creek, the Bush River Tributary, James Run, and the Unnamed Tributary

A total of six surface water samples and six sediment samples were collected in August and October 1992 from locations within Bynum Run Creek, the Bush River Tributary, James Run, and the Unnamed Tributary. Two of these samples were background samples collected upstream of the Site in Bynum Run Creek and James Run. The background surface water and sediment sample from

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6 The AWQC is .087 mg/L for aluminum and 1.0 mg/L for iron.

James Run was the only sample taken from this stream. No organic contaminants were detected in any of the downgradient surface water or sediment samples. See Figure 2 for surface water and sediment sample locations.

For the two downgradient surface water samples collected from Bynum Run Creek (SW3 and SW4), the levels of inorganic constituents were generally below those observed at the upstream background locations. Total aluminum and dissolved mercury were detected in surface water samples from this creek at 0.0889 mg/l and 0.0003 mg/l respectively, which are above the AWQC. The AWQC for aluminum is 0.087 mg/l and the MCTSC for mercury is 0.000012 mg/l. The dissolved mercury level was recorded at both of the background locations. Also, there are concerns regarding the reliability of the data. These factors suggest that the mercury results are not representative of conditions in Bynum Run Creek. The zinc, manganese, and iron concentrations observed at sampling locations SW3 and SW4 were slightly above background levels. However, these contaminants are present at levels that do not represent an adverse impact to Bynum Run Creek. The concentration of inorganics in the sediment samples from Bynum Run Creek downstream of the landfill were generally lower than background levels and were below established ecological criteria (ER-L and ER-M values). See Tables 14 and 15 for a summary of constituents found in surface water and sediment samples from Bynum Run Creek.

The average concentration of iron and manganese and the maximum concentration of magnesium in the surface water samples from the Bush River Tributary were higher than the maximum levels observed in the background samples. The concentrations of these inorganic constituents did not exceed established ecological criteria (either AWQC or MCTSC) and these inorganics are not considered deleterious to aquatic life at the detected concentrations. The levels of six inorganics and cyanide in the sediment sample from the Bush River Tributary exceeded background concentrations but did not exceed established ecological criteria (ER-L and ER-M values). See Tables 16 and 17 for a summary of constituents found in surface water and sediment samples from the Bush River Tributary.

The surface water samples from the Unnamed Tributary contained levels of seven inorganics above those observed in the background samples. The concentrations of total aluminum (0.337 mg/l), total iron (14.7 mg/l), and dissolved iron (8.14 mg/l) were above established ecological criteria7. The sediment sample for this location was fine-grained and composed of fine silt.

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7 The AWQC for aluminum is 0.087 mg/l and the AWQC for total as well as dissolved iron is 1.0 mg/l.

The levels of inorganics in the sediment sample from the Unnamed Tributary were generally higher than those observed in Bynum Run Creek, Bush River Tributary, and James Run. The concentration of lead in the sediment sample from the Unnamed Tributary was above the ER-L value but below the ER-M value. See Tables 17 and 18 for a summary of constituents found in surface water and sediment samples from the Unnamed Tributary.

d. Marsh Sediment

Nine marsh sediment samples were collected in August 1992 from the BDNRMA adjacent to the landfill. The Site is located at the headwaters of the adjacent freshwater tidal marsh; therefore, background marsh samples were not attainable.

A total of sixteen inorganics were detected in marsh sediment samples. The concentrations of inorganics in the marsh samples were generally higher than those observed in stream sediments. Lead and mercury were present at levels above the available ecological guidelines, 37.6 mg/Kg and 0.19 mg/Kg respectively. The ER-L for lead is 35 mg/Kg and the ER-L for mercury is 0.15 mg/Kg. Although above the ER-L, both lead and mercury concentrations were below the ER-M values of 100 mg/Kg for lead and 1.3 mg/Kg for mercury. Seven organics, mostly semi-volatiles, were also detected in the marsh sediment samples at levels below the ER-L and ER-M values. See Table 19 for a summary of constituents found in sediment samples from the marsh.

6. Ambient Air

A three-phase ambient air quality monitoring program was performed at the Site on April 16, 1992, September 16, 1992, and December 16, 1992. The air sampling program was implemented to preliminarily assess the nature and extent of the potential migration of Site-related VOCs in the ambient air. During each sampling event, one upwind sampling location and two downwind sampling locations were established.

Thirteen VOCs were detected at upwind sampling locations, eleven of which were also detected at downwind locations. There were two contaminants (chloroform and chloromethane) detected at upwind locations that were not detected at downwind locations and one contaminant (carbon tetrachloride) detected at downwind locations that was not detected at upwind locations. The highest VOC concentration at both upwind and downwind locations was for methylene chloride (240 ug/m3). The detection of VOCs in the upwind sampling locations suggests that the extent of ambient air contamination is not fully understood at the Site. See Tables 20 and 21 for a summary of contaminants detected at upwind and downwind locations.

The air sampling program was implemented during the RI due to a concern that landfill gasses emanating from the Site could be contributing to the risk at the Site. However, data from the air sampling program was inconclusive, making it impossible to perform a quantitative risk assessment for landfill gas. A remedial action is required at this Site based on the risks associated with the ground water. Since a remedial action will be taken at this Site, although risks associated with landfill gas have not been fully assessed, the ARARs8 associated with landfill gasses will still have to be met. Additional air monitoring data will be obtained during remedial design and after implementation of the selected remedy.

VI. Summary of Human Health Risks

As part of the RI/FS process, EPA conducted an analysis to identify human health risk that could exist if no action were taken at the Site. This analysis, completed in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan ("NCP"), 40 C.F.R. Part 300, is referred to as a baseline risk assessment. This assessment provides the basis for taking action and indicates the exposure pathways that need to be addressed by the remedial action.

In general, a baseline risk assessment is performed in four steps: (1) data collection and evaluation, (2) the exposure assessment, (3) the toxicity assessment, and (4) risk characterization. This section of the ROD will summarize the result of each of these steps.

A. Data Collection and Evaluation

The data described in the previous section were evaluated for use in the baseline risk assessment. This evaluation involved reviewing the quality of the data and determining which data were appropriate to use to quantitatively estimate the risks associated with Site soil, leachate, sediment, surface water, and ground water.

The analytical results from samples collected during the RI were used to estimate the exposure point concentrations (also know as representative or Reasonable Maximum Exposure ("RME") concentrations) for use in the baseline risk assessment. For chemical concentrations, the RME may be estimated by using the 95% upper confidence limit ("UCL") on the mean of a sample set. If the 95% UCL of the mean exceeded the maximum detected concentration, then the maximum concentration was substituted as the RME concentration for the risk calculations. Representative concentrations were calculated for each of the contaminants of potential concern ("COPC") for each media sampled, where possible. UCLs could not be calculated for small data sets, including evaluations for most surface water and sediment locations, and residential wells, where fewer than five samples were available. For such data sets, the representative concentration was the maximum positive concentration. The RME was calculated according to EPA risk assessment guidance. The COPCs and their respective exposure point concentrations for all of the media at the Site that were evaluated during the risk assessment are presented in Table 22.

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8 Applicable and Relevant and Appropriate Requirements.

B. Exposure Assessment

There are three basic steps involved in an exposure assessment: 1) identifying the potentially exposed populations, both current and future, 2) determining the pathways by which these populations could be exposed, and 3) quantifying the exposure. Under current Site conditions, the populations that could be potentially exposed to contaminants in onsite surface soil, surface water, sediment, and leachate are primarily trespassers/current local residents. There are residences located within 100 feet of the landfill and in some instances the landfill extends onto these residential properties. Therefore, both current and future residential use of the Site were considered in the baseline risk assessment. Access to offsite surface water and sediment is unrestricted, and it is anticipated that current local residents could be exposed to these media. A locked gate prohibits vehicular access to the Site; however, there are no barriers to pedestrian access. Also, current local residents as well as potential future residents could be exposed to contaminated ground water at the Site and in the Site vicinity.

The potential pathways for exposure include: 1) ingestion of onsite soils, sediments, leachate, and/or ground water, 2) dermal contact with onsite soils, sediments, leachate, and/or ground water, 3) inhalation of airborne contaminants from ground water.

In order to quantify the potential exposure associated with each pathway, assumptions must be made with respect to the various factors used in the calculations. Table 23 summarizes the values used in the baseline risk assessment.

C. Toxicity Assessment

The purpose of the toxicity assessment is to weigh available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals. Where possible, the assessment provides a quantitative estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects.

A toxicity assessment for contaminants found at a Superfund site is generally accomplished in two steps: 1) hazard identification, and 2) dose-response assessment. Hazard identification is the process of determining whether exposure to an agent can cause an increase in the incidence of a particular adverse health effect (e.g., cancer or birth defects) and whether the adverse health effect is likely to occur in humans. It involves characterizing the nature and strength of the evidence of causation.

Dose-response evaluation is the process of quantitatively evaluating the toxicity information and characterizing the relationship between the dose of the contaminant administered or received and the incidence of adverse health effects in the administered population. From this quantitative dose-response relationship, toxicity values (e.g., reference doses and slope factors) are derived that can be used to estimate the incidence or potential for adverse effects as a function of human exposure to the agent. For the purpose of the risk assessment, contaminants were classified into two groups: carcinogens and noncarcinogens. The risks posed by these two types of compounds are assessed differently because noncarcinogens generally exhibit a threshold dose below which no adverse effects occur, while no such threshold can be proven to exist for carcinogens. As used here, the term carcinogen means any chemical for which there is sufficient evidence that exposure may result in continuing uncontrolled cell division (cancer) in humans and/or animals. Conversely, the term noncarcinogen means any chemical for which the carcinogenic evidence is negative or insufficient.

Slope factors have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic contaminants of concern. Slope factors, which are expressed in units of (mg/kg/day)-1, are multiplied by the estimated intake of a potential carcinogen, in mg/kg/day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper-bound" reflects the conservative estimate of the risks calculated from the slope factor. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Slope factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). Slope factors used in the baseline risk assessment are presented in Table 24.

Reference doses ("RfDs") have been developed by EPA to indicate the potential for adverse health effects from exposure to contaminants of concern exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg/day, are estimates of lifetime daily exposure levels which are likely to be without adverse effects for humans, including sensitive individuals. RfDs are derived from human epidemiological or occupational studies, or from animal studies, and incorporate uncertainty factors. The uncertainty factors account for differences between members of a population, differences between humans and animals, and other sources of uncertainty. Reference doses used in the baseline risk assessment are presented in Table 24.

D. Human Health Effects

The health effects of the Site contaminants that are most closely associated with the unacceptable risk levels are summarized below. In most cases, the information in the summaries is drawn from the Public Health Statement in the Agency for Toxic Substances and Disease Registry's ("ATSDR") toxicological profile for the chemical.

Aluminum: Aluminum is a common, virtually ubiquitous element. This metal has been used in the smelting, refining, electrical, aircraft, automotive, jewelry, petroleum processing, and rubber industries. Aluminum foil is widely used in packaging. Aluminum is not generally noted for toxicity. Some aluminum salts have been associated with skin and respiratory irritation. Inhalation of aluminum powder has been reported to cause pulmonary fibrosis. Some studies have suggested a link between aluminum exposure and Alzheimer's disease. Aluminum has not been classified as a carcinogen by EPA.

Arsenic: Arsenic has been used by the agricultural, pigment, glass, and metal smelting industries. Arsenic is a ubiquitous metalloid element. Acute ingestion of arsenic can be associated with damage to mucous membranes including irritation, vesicle formation, and sloughing. Arsenic can also be associated with sensory loss in the peripheral nervous system and anemia. Liver injury is characteristic of chronic exposure. Effects of arsenic on the skin can include hyperpigmentation, hyperkeratosis, and skin cancer. EPA classifies arsenic in drinking water as a Group A known oral human carcinogen.

Berillium: The respiratory tract is the major target of inhalation exposure to beryllium. Short-term exposure can produce lung inflammation and pneumonia-like symptoms. Long-term exposure can cause berylliosis, an immune reaction characterized by noncancerous growths on the lungs. similar growths can appear on the skin of sensitive individuals exposed by dermal contact. Epidemiological studies have found that an increased risk of lung cancer may result from exposure to beryllium in industrial settings. In addition, laboratory studies have shown that breathing beryllium causes lung cancer in animals. However, it is not clear what cancer risk, if any, is associated with ingestion of beryllium. EPA has classified beryllium as a Group B2 probable human carcinogen based on the limited human evidence and the animal data.

Cadmium: Cadmium cancause a number of adverse health effects. Ingestion of high doses causes severe irritation to the stomach, leading to vomiting and diarrhea, while inhalation can lead to severe irritation of the lungs and may cause death. People have committed suicide by drinking water containing high levels of cadmium. There is very strong evidence that the kidney is the main target organ of cadmium toxicity following chronic exposure. Long-term ingestion of cadmium has caused kidney damage and fragile bones in humans. Long-term human exposure by the inhalation route may cause kidney damage and lung disease such as emphysema. The most sensitive or critical effect of cadmium exposure is high concentrations Of protein in urine, indicative of abnormal kidney function. Long-term inhalation of air containing cadmium by workers is associated with an increased risk of lung cancer. Laboratory rats that breathe cadmium have increased cancer rates. Studies of humans or animals have not demonstrated increased cancer rates from eating or drinking cadmium. EPA classifies cadmium as a Group B1 probable human inhalation carcinogen based on occupational studies.

Chromium: There are two major forms of chromium, which differ in their potential adverse health effects, found in the environment. One form, chromium VI (chromium 6+), is irritating; short-term, high-level exposure can result in adverse effects at the site of contact, causing ulcers of the skin, irritation and perforation of the nasal mucosa, and irritation of the gastrointestinal tract. Minor to severe damage to the mucous membranes of the respiratory tract and to the skin have resulted from occupational exposure to as little as 0.1 mg/m3 chromium VI compounds. Chromium VI may also cause adverse effects in the kidney and liver. Long-term occupational exposure to low levels of chromium VI compounds has been associated with lung cancer in humans. Chromium VI is classified by EPA as a Group A known human carcinogen based on evidence from epidemiological studies. The second form, chromium III (chromium 3+), does not result in these effects and is the form thought to be an essential nutrient. The only effect observed in toxicological studies of chromium III is a decrease in liver and spleen weights in rats. This effect was used as the basis for the RfD.

1,2-Dichloroethane (1,2-DCA): The lungs, heart, liver, and kidneys are the organs primarily affected in both humans and animals exposed to 1,2-DCA. Short-term exposure to 1,2-DCA in air may result in an increased susceptibility to infection and liver, kidney, and/or blood disorders. Effects seen in animals after long-term exposure to 1,2-DCA included liver, kidney, heart disease, and/or death. 1,2-DCA has caused increased numbers of tumors in laboratory animals when administered in high doses in the diet or on the skin and is classified as a Group B2 probable human carcinogen.

1,2-Dichloropropane: 1,2-Dichloropropane is a solvent that can be used as a fumigant, scouring compound, and degreaser. 1,2-Dichloropropane can irritate the skin and eyes and can cause dermatitis. 1,2-Dichloropropane can also cause liver, kidney, and heart damage. Fatty degeneration of the liver and kidney have been reported in animals. 1,2-Dichloropropane is classified as a Group B2 probable human carcinogen by EPA via the oral route, based on the occurrence of liver tumors in mice.

Manganese: Manganese is used in the manufacture of dry cell batteries, paints, dyes, and in the chemical and glass and ceramics industries. Manganese is an essential nutrient in food; the average human intake is reported to be approximately 10 mg/day. Previous reports of neurotoxicity from manganese were generally reported from high-level occupational exposure to dust and fumes. More recent studies have focused on exposures to drinking water, with subtle neurologic effects being reported after chronic consumption of high concentrations of manganese in water. Manganese is not classified as a carcinogen by EPA.

Nickel: Nickel is a metal that has been associated with ore refining, stainless steel, electroplating, jewelry, plastics, batteries, enamels, coal oils, and a variety of other industries. Nickel, a skin sensitizer, can cause dermatitis. The kidney and circulatory system may also be potential target organs. Nickel has not been classified as a carcinogen by EPA.

Tetrachloroethene (PCE): Tetrachloroethene, also known as perchloroethylene, is a commonly used solvent in the dry cleaning, degreasing, and textile industries. It is also used as an intermediate in the manufacture of organic chemicals. Irritation of the skin can occur after dermal exposure. High-level inhalation exposure can cause respiratory and eye irritation. Other effects include CNS depression and liver damage. EPA ECAO classifies PCE as a Group B2 probable human carcinogen, although this is not considered an Agency-wide consensus at this time.

Trichloroethene (TCE): Trichloroethene has been used as a solvent in degreasing operations associated with both metal-using industries and dry cleaning. TCE has been used as an intermediate in the production of pesticides, waxes, gums, resins, paints, varnishes, and trichloroacetic acid. TCE toxicity can include dermatitis, CNS depression, anesthesia, and effects on the liver, kidneys, and heart. TCE is a volatile compound, and inhalation exposure may be significant. The carcinogenicity of TCE is currently under review.

Vanadium: Vanadium is a ubiquitous element. It has been associated with petroleum refining, steel industries, pigments, glass manufacturing, photography, and insecticides. Toxicity is usually reported after industrial inhalation exposure, which can be associated with bronchitis, bronchopneumonia, irritation, GI distress, heart palpitations, and kidney damage. Ingestion of vanadium has been associated with GI disturbances and renal and nervous system effects. Experimental studies suggest the liver, adrenals, and bone marrow as target organs. Vanadium has not been classified as a carcinogen by EPA.

Vinyl Chloride (VC): VC may cause adverse health effects following exposure by inhalation, ingestion, or by dermal or eye contact. VC inhalation can cause dizziness or sleepiness. Breathing very high levels of VC can cause unconsciousness and in some cases death. On skin, exposure to liquid VC can cause burns. Noncarcinogenic effects associated with long-term occupational VC exposure include hepatitis-like changes in the liver, immune reactions, and nerve damage. VC has been shown to cause liver and lung cancer in rats and liver cancer in workers occupationally exposed to air concentrations in the range of 25 ppm to greater than 200 ppm. Based on this evidence, EPA has classified VC as a Group A human carcinogen. Air standards as low as 1 ppm are specified for occupational exposure to VC in many countries.

E. Risk Characterization

The risk characterization process integrates the toxicity and exposure assessments into a quantitative expression of risk. For carcinogens, the exposure point concentrations and exposure factors discussed earlier are mathematically combined to generate a chronic daily intake value that is averaged over a lifetime (i.e., 70 years). This intake value is then multiplied by the toxicity value for the contaminant (i.e., the slope factor) to generate the incremental probability of an individual developing cancer over a life-time as a result of exposure to the contaminant. Cancer risks are generally expressed in scientific notation (e.g., 1x10-6, otherwise expressed as 1E-6). An excess lifetime cancer risk of 1x10-6 indicates that, as a reasonable maximum estimate, an individual has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at the site. The generally acceptable excess cancer risk range, as defined by Section 300.430 (e)(2)(i) (A)(2) of the NCP, is between 1.0 x 10-4 to 1.0 x 10-6. These cancer risks are summarized in Table 25.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (i.e., the chronic daily intake) with the toxicity of the contaminant for a similar time period (i.e., the reference dose). The ratio of exposure to toxicity is called a hazard quotient. A Hazard Index ("HI") is generated by adding the appropriate hazard quotients for contaminants to which a given population may reasonably be exposed. Any media with an HI greater than 1.0 has the potential to adversely affect health. These non-cancer risks are simmarized in Table 26.

When evaluating the data to be used in predicting the risk associated with exposure to contaminated ground water, it was observed that there were two rather distinct areas of contamination. While VOCs were detected throughout the Site, the center of this plume appears to be in the vicinity of monitoring wells 2, 3, and 4, which are located to the south and east of the Site. These wells make up ground water Area 1 selected for quantitative risk assessment. On the north side of the landfill, the concentrations of organics were lower, but concentrations of metals in ground water were higher. Therefore, monitoring wells 5, 6, and 8 comprise ground water Area 2 selected for quantitative risk assessment.

Unacceptable cancer and systemic health risks were identified with respect to the future use scenario, specifically hypothetical future ground-water use. The excess lifetime cancer risk determined under the future use exposure scenario from incidental inhalation, ingestion, and dermal absorption of contaminants in ground water is 9 x 10-4 for Area 1 and 3.5 x 10-4 for Area 2. In other words, if no remedial action is taken, approximately nine individuals out of every ten thousand people exposed to the ground water in Area 1 have a chance of developing cancer as a result of the exposure and approximately three to four individuals out of every ten thousand people exposed to the ground water in Area 2 have a chance of developing cancer as a result of the exposure. In Area 1, the majority of this risk is due to the presence of 1,2-dichloroethane, vinyl chloride, and tetrachloroethene, the individual cancer risks for each of which exceed 1 x 10-4. In Area 2, the majority of this risk is due to the presence of beryllium and vinyl chloride, the individual cancer risks for each of which exceed 1 x 10-4. The baseline risk assessment did not identify any other unacceptable carcinogenic health risks associated with the remaining Site media (onsite soils, leachate, surface water, or sediments). However, it should be noted that because the air monitoring results during the RI were inconclusive, risks due to exposure to landfill gasses were not quantitatively evaluated.

The HI for the future land use scenario was developed separately for the adult resident and child resident. With respect to noncarcinogenic systemic risks, a total HI of greater than one was calculated for a number of VOCs and metals. For potential future residents exposed to the representative concentrations of the contaminants of concern in ground water Area 1, the HIs would be 16.9 for adults and 37.3 for children

(if split data are not considered). If split data are considered, the HIs for Area 1 would be 17.4 for adults and 38.4 for children. For Area 2 the HIs are estimated at approximately 41.9 for adults and 95.2 for children. Potential future use of ground water in these areas could pose non-carcinogenic health risks. These risks are due mainly to VOCs and manganese and are summarized in Table 26.

The evaluation of human health risks (both carcinogenic and noncarcinogenic) from exposure to the ground water is intended to provide a reference point for evaluating future ground water risks; it does not represent actual present day exposures since residents in the vicinity of the Site are connected to a public water supply.

The baseline risk assessment did not identify any unacceptable non-carcinogenic health risks associated with the remaining Site media (contaminated soils, landfill contents, marsh and stream sediments, leachate, and surface water). However, if no action were taken, the landfill contents and the associated contaminated soils would represent a continuing source of contaminants to the ground water.

Actual or threatened releases of hazardous substances from this Site, if not addressed by the selected remedy or one of the other active measures considered, may present a current or potential threat to public health and welfare.

VII. Summary of Environmental Risks

EPA evaluated the potential for ecological impacts at the Site in the Bush Valley Landfill Ecological Risk Assessment dated August 8, 1994. The ecological risk assessment indicates that certain Site media show a potential for risk to ecological receptors. Evidence of ecological effects have been limited to observations during onsite activities. Because no tissue analyses or bioassays were performed, the assessment employs a conservative approach using Environmental Effects Quotients ("EEQs") based on statistically derived concentrations of contaminants found onsite and in the study area.

The ecological risk assessment indicated that numerous organic and inorganic contaminants were found at levels which have the potential to cause adverse ecological impacts in the following five major media: soils, stream sediment, marsh sediment, ground water, and leachate. The contaminants of concern in these media are identified below.

Contaminants of Concern

Soils:	Aluminum	
	Chromium	
	Cadmium	
	Cobalt	
	Manganese	
	Di-n-butylphthalate	
Stream Sediment:	Aluminum	
	Iron	
	Cyanide	
	Manganese	
Marsh Sediment:	Aluminum	
	Beryllium	
	Cyanide	
	Iron	
	Manganese	
Ground Water:	Aluminum	
	Chromium (VI)	
	Cobalt	
	Copper	
	Iron	
	Manganese	
Leachate:	Aluminum	Lead
	Cadmium	Manganese
	Chromium (VI)	Mercury
	Cobalt	Nickel
	Copper	Silver
	Iron	Zinc

The ecological risk assessment concluded that the potential exists for impact to ecological receptors due to threatened or actual releases of hazardous substances from the Site. This assessment, based on Federal Ambient Water Quality Criteria as well as calculations of EEQ's for Site-related media, concludes that the Site is the source of several contaminants that could pose a risk to ecological receptors. It is apparent from the conclusions drawn in the ecological risk assessment that additional ecological characterization is needed for this Site. Although the selected remedy indirectly addresses ecological concerns, it is possible that additional response actions will be necessary, based on results obtained during the long-term monitoring program. In that event, the additional response actions would be selected and implemented.

Actual or threatened releases of hazardous substances from this Site, if not addressed by the selected remedy or one of the other active measures considered, may present a current or potential threat to the environment.

VIII. Description of Alternatives

In accordance with Section 300.430(e)(9) of the NCP, 40 C.F.R. Section 300.430(e) (9), remedial response actions were identified and screened for effectiveness, implementability, and cost during the FS to meet the remedial action objectives ("RAOs") established for the Site. The RAOs are as follows: (1) the elimination of the potential for direct contact of human or environmental receptors with landfill contents, onsite soils, leachate, and landfill gas; and (2) the elimination of the potential for exposure of human receptors to contaminated ground water via ingestion or inhalation. The technologies that passed the screening mentioned above were assembled to form remedial alternatives. The alternatives were then evaluated using the nine criteria required by 40 C.F.R. Section 300.430(e)(9). The FS evaluated a variety of technologies used in the development of alternatives for addressing the sources of contamination at the Site as well as the existing ground water plume. As detailed in the FS, the technologies and the approaches contained in the alternatives listed below were determined to be the most appropriate for this Site. Additionally, it has been determined that use of the presumptive remedy guidance for municipal landfills is appropriate for this Site. The descriptions of the Alternatives 1 through 5 below are derived from the descriptions in the FS. The capital costs, operation and maintenance ("O&M") costs, present worth costs, and implementation times for each of the alternatives listed below are estimates based on currently available information.

A. Common Elements

All of the alternatives will include a periodic review pursuant to Section 121(c) of CERCLA, 42 U.S.C. § 9621(c). With the exception of Alternative 1, the No Action alternative, all of the alternatives include institutional controls and a monitoring program. The institutional controls would include deed, land use, and access restrictions.

Deed restrictions would be placed on the property where landfill contents remain ("the landfill property") to prohibit (1) any activity that would interfere with the integrity of the remedy, until such time as EPA, in consultation with MDE, determines that such deed restrictions are no longer necessary to protect public health and the environment; and (2) the use of ground water under the landfill property for domestic purposes, including drinking water, until such time as EPA has determined that the ground water performance standards, defined later in this document, have been met. Land use restrictions would also be instituted which would prohibit use of ground water for domestic purposes, including drinking water, from under any other land parcels in the area to which contaminated ground water from the landfill property exceeding the 1 x 10-4 risk level has migrated, until such time as EPA has determined that the ground water performance standards, defined later in this document, have been met. Access restrictions would include fencing and signage. A perimeter fence would be constructed along the boundary of the Site to limit the direct contact exposure pathways of would-be trespassers and vehicular traffic. No-trespassing signs would be posted along the fence. For each alternative that includes a fence, the integrity of the fence would be inspected on a quarterly basis. For cost estimation purposes only, a duration of 30 years is typically used for operation and maintenance tasks such as fence inspection. However, it should be noted that fence inspection may be required indefinitely.

A monitoring program would be instituted for surface water and sediments from the adjacent wetland area and nearby streams as well as for the ground water at the Site. This program would be implemented to periodically assess the contaminant levels of these media and monitor the progress of contaminant degradation. At this time, the available data does not show the need to design and operate an active treatment system for the ground water or the need for active remediation measures in the streams and wetland areas. EPA will use the results of the monitoring program to determine whether additional remedial measures would be required for these media in the future to provide protection of human health and the environment. For cost estimation purposes only, 30 years is typically assumed for the duration of monitoring programs. However, the duration and frequency of the monitoring program for this Site over the long term will be based on the results of the sampling program.

The ground water monitoring program would include sampling of designated existing ground water wells and installation and sampling of approximately five (5) new monitoring wells. The number of new wells was estimated at five for cost estimation purposes only; however, the actual number of new wells will be determined based on information obtained during remedial design. Also during the remedial design, EPA will determine the exact locations for the additional monitoring wells and the surface water and sediment sampling points. Laboratory analysis would be performed for the identified constituents of concern at the Site. Sampling and analysis would initially be conducted on a semi-annual basis for a period of at least two years. The results would be evaluated to determine the appropriate frequency for subsequent sampling.

The following table depicts additional elements for the alternatives that were evaluated in the FS:

TABLE 27

ALTERNATIVES:	1	2	3	4a	4b	5
SINGLE BARRIER COVER SYSTEM			x	x	x	
STORMWATER CONTROLS			x	x	x	x
LANDFILL GAS MANAGEMENT			x	x	x	x
GROUND WATER EXTRACTION				x	x	
GW TREATMENT (ACTIVE/PASSIVE)				x	x	

B. Alternative 1: NO ACTION

Capital Cost: $ -0-
Annual O&M Cost: $ -0-
Total Present Worth: $ -0-

Section 300.430(e)(6) of the NCP, 40 C.F.R. § 300.430(e)(6). requires that a "no action" alternative be evaluated at every NPL site in order to establish a baseline for comparison. Under this alternative, EPA would take no further remedial actions at the Site to prevent exposure to the contaminated media or to reduce risks at the Site.

C. Alternative 2: INSTITUTIONAL CONTROLS

Capital Cost: $ 155,000
Annual O&M Cost: $ 91,000
Total Present Worth: $ 1,300,000

Alternative 2 consists of land use restrictions, access restrictions, and a monitoring program. These measures are described under the common elements heading above.

D. Alternative 3: SINGLE BARRIER COVER SYSTEM AND LANDFILL GAS MANAGEMENT

Capital Cost: $ 3,800,000
Annual O&M Cost: $ 160,000
Total Present Worth: $ 5,700,000

Alternative 3 consists of deed restrictions, access restrictions, and a monitoring program, as described under the common elements heading above. Additionally, under Alternative 3, a single barrier cover system, a stormwater conveyance system, and a landfill gas management program would be implemented as described below. This alternative would eliminate direct exposure pathways to landfill wastes and onsite soils, reduce vertical infiltration of precipitation in order to control leachate seeps and migration of contaminants into the ground water, control surface water runoff and landfill gas migration, and reduce ground water contamination levels via natural attenuation.

Site preparation for this alternative would involve regrading the landfill surface and side slopes. This activity would provide drainageways for surface water runoff from the landfill area and would minimize ponding of water on the surface of the landfill. The purpose of these regrading activities would be to provide a proper foundation for the single barrier cover system described below.

The single barrier cover system is constructed of several layers and serves to isolate the landfill waste. Figure 4 depicts a typical single barrier cover system. These layers can vary based on Site-specific conditions. Final specifications for the cover system for Alternative 3 would be determined during remedial design. The first layer to be installed, called the "bedding layer," would be placed directly on the surface of the landfill. EPA guidance recommends that the bedding layer be between 12 and 24 inches thick. At this Site, materials provided by the regrading activities may serve as a portion of the bedding layer. However, if the volume of these materials is not adequate to provide a 12 to 24 inch layer over the entire landfill, additional compacted soil materials would be needed to complete the bedding layer.9

When landfill gas management systems are included in remedial alternatives, as is the case for Alternative 3, a gas collection layer is incorporated into the single barrier cover system. This layer, sometimes called the "gas venting layer," is placed on top of the bedding layer. The gas venting layer is typically a 12 inch thick layer of sand, gravel, or other granular material. The granular material provides a preferential pathway over the entire waste area to allow for migration of landfill gas. Landfill gas migrating from the waste area would be collected and vented to the atmosphere via the gas collection layer in conjunction with the other components of the landfill gas management system, described below.

The third layer, called the "barrier layer," is a relatively impermeable layer that decreases the amount of precipitation that

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9 The cost estimates for Alternatives 3 through 5 do not include the potential cost for any additional compacted soil for the bedding layer. Therefore, the actual costs for these alternatives may be slightly higher than shown.

reaches the waste in the landfill. The reduction of precipitation reaching the waste minimizes the decomposition of the waste material, which in turn reduces the generation of landfill gas and leachate. The material used for the barrier layer, either clay or a synthetic membrane, is required to have a permeability no greater than 1 x 10-7 cm/sec.

The fourth layer, called the "drainage layer," is made up of either 12 inches of a granular material or a synthetic drainage material. The drainage layer minimizes any pooling of water from precipitation which may occur on the barrier layer. This layer is designed to discharge collected water into the perimeter channels which ultimately transports the water to onsite retention basins. A synthetic filter fabric would be placed over the drainage layer to prevent any fine material from infiltrating into the drainage layer and clogging the void space.

The next layer of the single barrier cover system, the "protective layer," is made up of 18 inches of common borrow material. The purpose of the protective layer is to provide protection for the underlying layers.

The top layer of the cover system is the "vegetative layer." This layer is made up of 6 inches of nutrient-enriched topsoil to establish vegetation. The purpose ofthe overlying vegetative layer is to prevent erosion of the cover system by wind and rain,

The stormwater conveyance system would include a perimeter channel and three sedimentation basins to convey and collect runoff and sediment, respectively. The two existing sedimentation basins located in the southeast and northeast portions of the landfill would be redesigned to meet sediment and erosion control requirements. An additional sedimentation basin would be constructed along the northwest boundary to provide additional storage capacity for surface water collected from the northern and western portions of the landfill. Sediment would be removed from each basin periodically so that it would not accumulate to more than half the storage depth. The removed sediment would be disposed of offsite.10 The destination of this sediment would be determined during remedial design. Surficial vegetation and/or riprap would be utilized in the perimeter channels and sedimentation basins to reduce erosive surface water velocities. Additional interim sediment control measures, such as earth berms, silt fences, and straw bales, would be used during construction to direct and capture surface water flow and control offsite transport of sediment.

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10 The cost of disposal of sediment removed from the sedimentation basins (and of any accompanying requirements) has not been included in the operation and maintenance cost estimates listed in this section. Accordingly, the O&M costs may be higher that the given estimates.

The landfill gas management system would include a vertical gas interceptor, a gas collection layer (part of the single barrier cover system described above), and gas venting wells which would vent to the atmosphere. The vertical gas interceptor, a slurry wall, would form a below-ground impermeable barrier on the south side of the landfill. Gas venting wells would be installed, preferably towards the north side of the landfill, to create a preferential pathway for landfill gas from the gas collection layer to the atmosphere. Gas venting wells would be installed directly north of the slurry wall (interceptor gas venting wells). A single pipe would connect the interceptor wells and transport the gas away from the southern boundary of the Site before venting to the atmosphere. Vents to the atmosphere for this pipe collection system would be located on the north to northeast side of the Site. Routine monitoring of the venting equipment and the ambient air quality will be necessary since the venting system would be designed to vent to the atmosphere. This passive gas extraction system would be designed with the capacity to be converted to an active gas extraction system in the event that the entire system needs to be enhanced to increase the migration of gas from beneath the cover system.

Presently, it is not known whether VOC emissions from the landfill gas collection/venting system would exceed levels that require control under Federal and State regulations. Field data would be collected in order to assess landfill gas management requirements and air emission controls would be implemented as necessary to comply with the Federal and State applicable or relevant and appropriate requirements identified in this ROD.

Based on the rate of reduction of organic contaminants in existing monitoring wells over time, it has been estimated that the levels of organic contaminants present in the ground water will be reduced to non-detect levels via natural attenuation in approximately 13 years without the single barrier cover system11. It is anticipated that the combination of the single barrier cover system and natural attenuation will accelerate the reduction of the levels of organics in the ground water to acceptable levels in less than 13 years. Using information obtained from the ground water monitoring program, EPA would evaluate the effectiveness of natural attenuation. If contaminant levels are not sufficiently reduced, additional response actions may be required to address the ground water contamination.

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11 See June 1, 1995 memo from Barbara Rudnick (EPA Geologist) to Melissa Whittington (EPA Project Manager) in the Administrative Record.

Alternative 3 could be constructed within approximately 12 months following commencement of the remedial action. Major items to be installed during this 12-month period would include perimeter fencing, the single barrier cover system, stormwater conveyance system, and landfill gas management system.

Although the existing monitoring wells may be used as part of the ground water monitoring system, additional wells would likely be required to ensure the effectiveness of this monitoring system. The number of new wells was estimated at five for cost estimation purposes. However, the actual number of new wells will be determined using information obtained during remedial design. Also during remedial design, the existing wells would be sampled to evaluate the current conditions and identify appropriate locations for the new wells. The complete ground water monitoring program could be initiated following installation of the new monitoring wells. The wetland monitoring program could begin and deed and other land use restrictions could be implemented during the initial phases of remedial design.

E. Alternative 4a: SINGLE BARRIER COVER SYSTEM, LANDFILL GAS MANAGEMENT, AND ACTIVE GROUND WATER TREATMENT

Capital Cost:	$ 4.800.000
Annual O&M Cost:	$ 1,400,000
Total Present Worth:	$ 22,000,000

Alternative 4a consists of land use restrictions, access restrictions, and a monitoring program, as described under the common elements heading above. Alternative 4a also includes a single barrier cover system, a stormwater conveyance system, and a landfill gas management program, as described under Alternative 3. In addition, Alternative 4a includes a ground water extraction and active treatment component, as described below.

The ground water extraction and active treatment system would involve extraction of the ground water, onsite treatment of the extracted ground water, and discharge of the treated ground water to either a Publicly Owned Treatment Works ("POTW") or surface waters in the adjacent wetland. A pipeline could be extended to the Harford County sanitary collection system, which is approximately 100 feet from the Site. This collection system connects to the Harford County POTW, Soil Run Waste Water Treatment Plant. If it were determined during design that discharge to this POTW would be infeasible, then the treated ground water would be discharged to the adjacent wetland or the unnamed tributary located east of the Site. The ground water would be extracted via the existing ground water monitoring wells, if feasible. Additionally, approximately ten ground water extraction wells would be installed beyond the perimeter of the cap. The number of new extraction wells was estimated at ten for cost estimation purposes only; however, the actual number of new wells would be determined using information obtained during remedial design. The actual location of these extraction wells, as well as the rate of extraction, would also be determined during remedial design. The purpose of the extraction and treatment system would be to reduce the levels of organic contaminants in the ground water to MCLs and to reduce the levels of inorganics in the ground water to MCLs or background levels, whichever is higher.12 At this time, background levels of inorganic contaminants have not been clearly defined. Additional investigation of the ground water during remedial design would be necessary to define background. Preservation of the adjacent wetlands would be taken into account when designing the extraction system and determining the rate of ground water extraction.

Data obtained during the RI indicated the presence of volatile organic compounds ("VOCs") and heavy metals in the ground water. The pre-design data collection activities would verify the contamination levels in the ground water. The extracted ground water would be treated via air stripping to remove the VOCs. A mobile air stripping unit could be brought to the Site for this purpose. The air stripper could be equipped with carbon adsorption enhancements to polish the treated effluent prior to discharge, if necessary. During the RI, no MCL exceedances for metals were detected in downgradient monitoring wells. The total excess cancer risk, as discussed above, is primarily due to organic contaminants, not inorganic contaminants.13 Therefore, it is highly unlikely that metals

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12 The cost estimate for this alternative assumes 30 years of operation and maintenance for the ground-water extraction and treatment system. This is a conservative estimate. It has been estimated that natural attenuation will allow the levels of organic contaminants in the ground water to reach acceptable levels in less than 15 years. Inorganic contaminants may already be present at background levels; it has not yet been determined whether inorganics are Site-related. As a result, this alternative would most likely cost considerably less than $22 million estimated in the FS.

13 Although there may be some non-carcinogenic risk associated with inorganic contaminants in the ground water, the available data does not indicate with certainty whether or not this risk is Site-related. See discussion on page 48 regarding the relationship between Site-related levels and background levels for inorganic contaminants.

pretreatment would be necessary from a risk standpoint. However, metals pretreatment may be warranted in order to achieve maximum efficiency from the air stripping unit, to achieve ARARs, or as a pretreatment requirement prior to discharge to the POTW. Accordingly, metals pretreatment has been included in the cost estimate for this alternative.

The effluent from the treatment system would be discharged either to the adjacent wetland or to the POTW. Table 28 identifies applicable and relevant and appropriate requirements that would have to be met for surface water discharges. Presently, capacity at the Harford County POTW is available to handle the estimated volume of treated effluent; however, projected housing development may deplete this capacity. Evaluation of a discharge method would be performed during the remedial design to determine the most feasible and cost effective discharge option. The cost of discharge to the POTW has been included in the cost estimate for this alternative.

This alternative could be constructed within approximately 18 months following commencement of the remedial action. Major items to be installed during this 18-month period would include perimeter fencing, the single barrier cover system, the stormwater conveyance system, the landfill gas management system, and the ground water extraction and active treatment system. The ground water treatment system is expected to include air stripping and carbon adsorption, only. A mobile air stripping unit with carbon adsorption enhancements, if necessary, could be brought to the Site and set-up relatively quickly. If metals pretreatment were determined to be necessary, additional time would be needed for construction of the necessary treatment systems. The time required for implementation of the monitoring program and land use restrictions would be the same as described for Alternative 3.

F. Alternative 4b: SINGLE BARRIER COVER SYSTEM, LANDFILL GAS MANAGEMENT, AND PASSIVE GROUND WATER TREATMENT

Capital Cost:	$ 4,100,000
Annual O&M Cost:	$ 180,000
Total Present Worth:	$ 6,400,000

Alternative 4b consists of land use restrictions, access restrictions, and a monitoring program as described under the common elements heading above. Alternative 4b also includes a single barrier cover system, a stormwater conveyance system, and a landfill gas management program as described under Alternative 3. In addition, Alternative 4b includes a ground water extraction system as described under Alternative 4a and a passive ground water treatment component as described below.

The passive treatment system would be comprised of a riprap outfall and discharge to the marsh area for naturally occurring bioremediation by the wetland vegetation. The extracted ground water would flow over the riprap outfall to a riprap or grass erosion mat channel at the toe of the final cover system. Five culvert pipes would discharge the extracted ground water to the marsh area. The volatile organic compounds in the extracted ground water would be aerated by flowing over the riprap outfall. The FS assumed that the wetland species would remove the metals in the extracted ground water via natural processes. A Site-specific demonstration that the above-described treatment measures would adequately treat the extracted ground water without unacceptable effects on the wetland or the air would be necessary prior to full scale implementation of this passive treatment system.

This alternative could be constructed within approximately 18 months following commencement of the remedial action. Major items to be installed during this 18 month period would include perimeter fencing, the single barrier cover system, the stormwater conveyance system, the landfill gas management system, and the ground water extraction and passive treatment system. The time required for implementation of the monitoring program and land use restrictions would be the same as described for Alternative 3.

G. Alternative 5: COMPOSITE BARRIER COVER SYSTEM

Capital Cost:	$ 4,100,000
Annual O&M Cost:	$ 160,000
Total Present Worth:	$ 6,100,000

Alternative 5 consists of land use restrictions, access restrictions, and a monitoring program, as described under the common elements heading above. Alternative 5 also includes a stormwater conveyance system and a landfill gas management program as described under Alternative 3. In addition, Alternative 5 includes a composite barrier cover system as described below. This alternative would eliminate direct exposure pathways to landfill wastes and onsite soils, eliminate vertical infiltration of precipitation in order to control leachate seeps and migration of contaminants into the ground water, control surface water runoff and landfill gas migration, and reduce ground water contamination levels via natural attenuation.

A composite barrier cover system is very similar to a single barrier cover system (see Figure 5). However, the composite barrier system is designed to eliminate vertical infiltration of precipitation as opposed to reducing infiltration. The composite barrier cover system included in this alternative includes all of the layers described above for the single barrier system. The difference between the two systems is found in the barrier layer.

The barrier layer in the single barrier cover system can be either one foot of clay or a synthetic membrane, as long as the maximum permeability of the layer is 1 x 10-7 cm/sec. The barrier layer in the composite barrier cover system consists of both one foot of clay and a synthetic membrane, each with a maximum permeability of 1 x 10-7 cm/sec. This combination is designed to eliminate vertical infiltration.

The layers included in a composite barrier cover system can vary based on Site-specific conditions. Final specifications for the cover system for Alternative 5 would be determined during remedial design.

Based on the rate of reduction of organic contaminants in existing monitoring wells over time, it has been estimated that the levels of organic contaminants present in the ground water would be reduced to non-detect levels via natural attenuation in approximately 13 years without the composite barrier cover system. It is anticipated that the combination of the composite barrier cover system and natural attenuation would accelerate the reduction of the levels of organics in the ground water to acceptable levels in less than 13 years. EPA would evaluate the effectiveness of natural attenuation using information obtained from the ground water monitoring program. If contaminant levels are not sufficiently reduced, additional response actions may be required to address the ground water contamination.

Alternative 5 could be constructed within approximately 12 months following commencement of the remedial action. Major items to be installed during this 12-month period would include perimeter fencing, the composite barrier cover system, the stormwater conveyance system, and the landfill gas management system. The time required for implementation of the monitoring program and land use restrictions would be the same as described for Alternative 3.

IX. Summary of Comparative Analysis of Alternatives

The six remedial action alternatives described above were assessed in accordance with the nine evaluation criteria set forth in the NCP at 40 C.F.R. § 300.430(e)(9). These nine criteria are categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The criteria associated with each group are as follows:

THRESHOLD CRITERIA

1. Overall protection of human health and the environment; and
2. Compliance with applicable or relevant and appropriate requirements ("ARARs").

PRIMARY BALANCING CRITERIA

3. Long-term effectiveness and permanence;
4. Reduction of toxicity, mobility, or volume through treatment;
5. Short-term effectiveness;
6. Implementability; and
7. Cost.

MODIFYING CRITERIA

8. State acceptance; and
9. Community acceptance.

These evaluation criteria are based on the requirements of Section 121 of CERCLA, 42 U.S.C. § 9621, and the NCP.

Threshold criteria must be satisfied in order for a remedy to be eligible for selection. Primary balancing criteria are used to weigh major trade-offs between remedies. State and community acceptance are modifying criteria formally taken into account after public comment is received on the Proposed Plan. A summary of the relative performance of the alternatives with respect to each of the nine criteria follows. This summary provides the basis for determining which alternative provides the "best balance" of tradeoffs with respect to the nine evaluation criteria.

A. Overall Protection of Human Health and the Environment

A threshold requirement of CERCLA is that the selected remedial action be protective of human health and the environment. Achievement of overall protection of human health and the environment involves addressing any unacceptable and/or potential risks identified in the baseline risk assessment and the ecological risk assessment. There is no unacceptable current exposure risk, as defined by EPA guidance, at the Site for human receptors. However, an unacceptable risk was associated with potential exposure to future residential ground water users. In addition there is a potential human health risk due to exposure to landfill gasses emanating from the landfill. However, this latter risk could not be quantitatively evaluated in the baseline risk assessment because the data from landfill gas monitoring events were inconclusive.

Achievement of overall protection of human health and the environment also involves meeting the RAOs. As identified previously in this document, the RAOs for this Site are as follows: (1) the elimination of the potential for direct contact of human or environmental receptors with landfill contents, onsite soils, leachate, and landfill gas; and (2) the elimination of the potential for exposure of human receptors to contaminated ground water via ingestion or inhalation.

No actions would be taken to address the direct contact threats or the potential risks due to exposure to landfill gas under Alternative 1. In addition, no actions would be taken to address the potential risks posed by the contaminated ground water. Although natural attenuation would be expected to occur under this alternative, it would take approximately thirteen years before the levels of contamination in the ground water would achieve MCLs. No restrictions on access to or use of the ground water would be required during that time. For the reasons listed above, this alternative is not protective of human health or the environment. Therefore, Alternative 1 cannot be selected and thus will not be evaluated further in this comparative analysis.

Alternative 2 would provide a low degree of protection of human health and the environment. The risks associated with the contaminated ground water would be addressed through land use restrictions. Land use restrictions would preclude use of local ground water resources that are contaminated above health-based levels, thereby eliminating the exposure pathway of future ground water users to the contaminated ground water. Natural attenuation would be expected to occur under this alternative and the ground water would be monitored on a long-term basis. The long-term monitoring program would provide protection by evaluating the effectiveness of natural attenuation as well as allowing for detection of any increase in or migration of ground water contamination. Additional response actions may be identified and required for the ground water, based on the results of the monitoring program. The potential for direct human contact with contaminated onsite media under Alternative 2 would be reduced via fencing; however, this would not necessarily reduce the potential for exposure of environmental receptors to contaminated onsite media. Any risks that may be posed by exposure to landfill gas will not be addressed by this alternative.

Alternatives 3 and 5 are sufficiently protective of human health and the environment. For both of these alternatives, the risks associated with the contaminated ground water would be addressed through land use restrictions, as discussed above under Alternative 2. Additionally, the single barrier cover system included in Alternative 3 would reduce the vertical infiltration of precipitation through the landfill wastes and the composite barrier cover system included in Alternative 5 would essentially eliminate the vertical infiltration of precipitation through the landfill wastes. This reduction/ elimination of vertical infiltration would significantly reduce the potential for further degradation of the ground water quality; therefore, under these alternatives, it is anticipated that the decrease in contamination levels in the ground water as a result of natural attenuation would be accelerated. The ground water would also be monitored on a long-term basis under both of these alternatives, thereby allowing for an evaluation of the effectiveness of natural attenuation as well as the detection of any increase or migration of ground water contamination. Additional response actions, beyond those included under these alternatives, could be identified and required for the ground water, based on the results of the monitoring program. Both cover systems would eliminate the possibility of direct contact of human and environmental receptors with the contaminated onsite media. The landfill gas management system included under both of these alternatives would address the risks, if any, to human health posed by landfill gas by directing the landfill gas away from nearby residences, and by providing for treatment of the landfill gas if treatment were determined by EPA to be necessary to meet ARARs.

Alternatives 4a and 4b are fully protective of human health and the environment. For both of these alternatives, the risks associated with the contaminated ground water would be addressed through land use restrictions, as described above for Alternative 2. In addition, these alternatives include ground water extraction systems along with either active or passive treatment of the contaminated ground water. Extraction and treatment of the groundwater would directly reduce the overall ground water contamination and eliminate the potential for migration of the ground water contamination. The single barrier cover systems included in these alternatives would reduce the vertical infiltration of precipitation through the landfill wastes and thereby reduce the potential for further degradation of ground water quality, as well as eliminate the possibility of direct contact of human and environmental receptors with the contaminated onsite media. The landfill gas management system included under both of these alternatives would address any risks to human health posed by landfill gas by directing the landfill gas away from nearby residences, and by providing for treatment of the landfill gas if treatment is determined by EPA to be necessary to meet ARARs.

B. Compliance with ARARs

This criterion addresses whether a remedy will meet all of the Applicable or Relevant and Appropriate Requirements ("ARARs") contained in Federal and State environmental laws and State facility siting laws, and/or provides grounds for invoking a waiver under Section 121(d) (4) of CERCLA, 42 U.S.C. § 121(d) (4), and the NCP at 40 C.F.R. § 300.430(f) (1)(ii)(c).

Alternative 2 would not comply with the substantive requirements of 40 C.F.R. § 6.302(a) and (b) (relating to wetlands protection and floodplain management). Alternatives 3 through 5 would meet the requirements of existing Federal and State ARARs.14 ARARs are location, chemical and action specific. See Table 28 for a complete listing of ARARs related to this Site. See Section X (Selected Remedy) and Section XI (Statutory Determinations) for a list of ARARs that apply to the selected remedy.

Because the landfill area constitutes a single area of contamination ("AOC"), the Land Disposal Restrictions (LDRs") under the Resource Conservation and Recovery Act ("RCRA") are not applicable or relevant and appropriate to the movement of hazardous waste (e.g., as a result of grading) within this area. Any contaminated soil removed during the construction of the slurry wall would also be part of this same AOC and could therefore be deposited in the landfill and included in the area to be covered without triggering LDRs. 55 Fed. Reg. 8758 (March 8, 1990).

Waste resulting from monitoring activities or other investigation-derived waste, if not part of the same area of contamination as the landfill, will have to be disposed of offsite. This offsite disposal and all other offsite activities that are part of the remedy must be performed in compliance with all Federal, State and local substantive and procedural laws in effect at the time the offsite activity takes place. 55 Fed. Reg. 8758 (March 8, 1990).

The State has indicated that the state laws currently in effect and applicable to offsite shipments of hazardous waste are generally found in COMAR 26.13.01, 26.13.02, 26.23.23, and 26.23.04. This citation is provided here for information purposes. The legal requirement remains that offsite activities comply with all applicable laws in effect at the time the offsite activity takes place.

C. Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once the cleanup levels have been met.

Alternative 2 would provide a low degree of long-term effectiveness. Neither a single barrier nor composite barrier cover system is included in this alternative. Therefore, the potential would exist for further degradation of the aquifer.

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14 Alternative 1 is not considered to be a remedial action; therefore, the CERCLA Section 121 requirement that ARARs be met or waived is not triggered. However, this Alternative is not protective of human health and the environment and cannot be selected for that reason.

This alternative would not be effective in limiting the production of leachate seeps or landfill gas over the long term. The ground water and surface water monitoring programs would be effective in monitoring the migration of contaminants over the long-term. This alternative is not a permanent remedy in the sense that hazardous substances in the landfill would be left in place.

Alternatives 3 and 5 would provide a moderate degree of long-term effectiveness. Construction of the single or composite barrier cover system under these alternatives would reduce the potential for further degradation of the aquifer and reduce the potential for leachate seeps by limiting the vertical infiltration of contaminants to the ground water over the long term. It is anticipated that ground water contamination levels will be reduced via natural attenuation in conjunction with either the single barrier or composite barrier cover system. The ground water and surface water monitoring programs would be effective in monitoring the migration of contaminants over the long term as well as in evaluating the overall effectiveness of the remedy.

Under Alternatives 3 through 5, ambient air would be re-sampled to determine whether controls are needed to meet ARARs and to verify that the landfill gas management system is protective of human health and the environment over the long-term.

Alternatives 4a and 4b would be effective in the long-term. Construction of the single barrier cover system under these alternatives would reduce the potential for further degradation of the aquifer and reduce the potential for leachate seeps by limiting the vertical infiltration of contaminants to the ground water over the long-term. The ground water and surface water monitoring programs would be effective in monitoring the migration of contaminants over the long-term as well as in evaluating the overall effectiveness of the remedy. Alternatives 4a and 4b would be more effective in the long-term than Alternatives 3 and 5 because the existing ground water contamination would be reduced by ground water extraction and treatment.

Alternatives 3 through 5 are not considered permanent remedies because the waste present in the landfill would remain in place and the cover systems would require maintenance over the long-term in order to ensure the long-term effectiveness of these alternatives. In addition, for Alternatives 4a and 4b, maintenance would be required on the ground water extraction and treatment system to ensure long-term effectiveness.

D. Reduction of Toxicity, Mobility, or Volume through Treatment

This evaluation criterion addresses the degree to which a technology or remedial alternative reduces the toxicity, mobility, or volume of hazardous substances at a Site. Although Section 121(b) of CERCLA, 42 U.S.C. Section 9621(b), establishes a preference for remedial actions that permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances, EPA may use a combination of treatment and engineering controls to achieve protection of human health and the environment, as set forth in the NCP. Specifically, Section 300.430(a)(1)(iii)(B) of the NCP, 40 C.F.R. § 300.430(a) (1) (iii) (B), states that EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable. The preamble to the NCP identifies municipal landfills as a type of site where treatment of the waste may be impracticable because of either the size and/or heterogeneity of the contents. 55 Fed. Reg. 8704 (March 8, 1990). Waste in CERCLA landfills usually is present in large volumes and is a heterogeneous mixture of municipal waste frequently co-disposed with industrial and/or hazardous waste. Because treatment is usually impracticable, EPA generally considers containment to be the appropriate response action, or the "presumptive remedy," for municipal landfills. See Presumptive Remedy for CERCLA Municipal Landfill Sites, September 1993 (OSWER Directive 9355.0-49).

Alternatives 2, 3, and 5 do not include treatment of the affected media at the Site. Therefore, implementation of these alternatives would not result in any reduction in the toxicity, mobility, or volume of the constituents of concern throuqh treatment processes.

Construction of the single/composite barrier cover systems included in Alternatives 3 through 5 would reduce the vertical infiltration of precipitation, which would decrease leachate generation and decrease the mobility of contaminants.

The ground water extraction and treatment systems included in Alternatives 4a and 4b would reduce the toxicity, mobility, and volume of contaminants in onsite ground water through the implementation of either active or passive treatment systems.

E. Short-Term Effectiveness

This evaluation criterion addresses the period of time needed to achieve protection of human health and the environment, and any adverse impacts that may be posed during the construction and implementation period of a remedy, until cleanup goals are achieved. The time for completion of the remedial actions for each of the alternatives listed below does not include the time for long-term monitoring, which will be required for all of the alternatives. All of the time frames listed below are estimates.

Alternatives 2, 3, 4a, 4b, and 5 would all be protective of human health in the short-term. These alternatives would not adversely impact the health and safety of the community. Although there is the potential for short-term risks to the community from air emissions from the air-stripping unit (Alternative 4a), air emissions from the passive ground water treatment system (Alternative 4b), and air releases of landfill gas (Alternatives 3 through 5), air monitoring would be used to verify that these potential risks were addressed by the controls, if any, necessary to meet ARARs.

Under Alternatives 3 through 5, workers would be exposed to physical safety hazards associated with operation of heavy equipment during cover system construction and potentially exposed to air-borne contaminants due to the disturbance of surface soils during construction activities. However, these risks would be minimized by the use of experienced and trained personnel, the use of specialized equipment and adherence to health and safety procedures by the workers. Construction of the single/composite barrier cover system could have some short-term environmental impacts due to soil erosion, but these effects would be minimized through the use of standard engineering runoff controls.

Under Alternative 4a, if metals pretreatment were determined to be necessary for the contaminated ground water prior to air stripping and carbon adsorption, transportation of treatment residuals through the local communities could pose a marginal intermittent impact to these communities. These potential impacts would be minimized by requiring adherence to Department of Transportation ("DOT") regulations associated with transportation of hazardous wastes.

Alternative 2 could be completed within approximately 30 days of initiation of remedial action. Alternatives 3 and 5 could be completed within approximately 12 months of initiation of the remedial action. Alternatives 4a and 4b could be completed within approximately 18 months of initiation of the remedial action.

F. Implementability

This evaluation criterion addresses the technical and administrative feasibility of each remedy, including the availability of materials and services needed to implement the chosen remedy. The components of Alternative 2 would not pose any implementation problems.

The landfill gas management system and stormwater conveyance system included in alternatives 3, 4a, 4b, and 5 would not present any implementation difficulties.

The single or composite barrier cover systems included in Alternatives 3, 4a, 4b, and 5 could be constructed and maintained without difficulty. However, long-term maintenance and repairs would be required to ensure the integrity of the cover systems. The required labor, equipment, and materials are readily available to build the cover system.

The ground water extraction and active treatment system included in Alternative 4a would rely on proven technologies (air stripping, carbon adsorption, and possibly metals precipitation) and could be implemented without difficulty. The ground water extraction and passive treatment system included in Alternative 4b would require treatability studies to ensure that the system could effectively treat the contaminated ground water.

G. Cost Effectiveness

Section 121 of CERCLA, 42 U.S.C. § 9621, requires selection of a cost-effective remedy that protects human health and the environment and meets the other requirements of the statute. The alternatives are compared with respect to present worth cost, which includes all capital costs and operation and maintenance cost incurred over the life of the project. Capital costs include those expenditures necessary to implement a remedial action, including construction costs. All of the costs indicated below are estimates. The cost associated with each alternative that satisfied the threshold screening criteria is as follows:

TABLE 29

ALTERNATIVE	CAPITAL COST	ANNUAL O&M	TOTAL COST
2	155,000	91,000	1,300,000
3	3,800,000	160,000	5,700,000
4a	4,800,000	1,400,000	22,000,000
4b	4,100,000	180,000	6,400,000

5	4,100,000	160,000	6,100,000

The present worth costs of the remedial action alternatives range from $1,300,000 for Alternative 2 to $22,000,000 for Alternative 4a. Alternative 3 is the most cost-effective of the alternatives that provides protection of human health and the environment and meets both the RAOs for the Site and the ARARs for that alternative. The present worth cost of Alternative 3 is $5,700,000, as listed above.

H. State Acceptance

MDE has actively participated in selecting a remedy for this Site by, among other things, reviewing and commenting on the RI/FS Reports and the proposed Remedial Action Plan. MDE concurs with EPA's selected remedy (Alternative 3). MDE will continue to actively participate in the remediation of this Site by reviewing and commenting on the remedial design deliverables and throughout the remedial action phase of the project.

I. Community Acceptance

On June 26, 1995 a public meeting was held at the Edgewood High School, in Edgewood, Maryland to discuss the results of the RI/FS and EPA's preferred alternative for remediation of the Site. The public meeting had been advertised in two local newspapers, The Aegis and The Record; however, the public meeting was sparsely attended. No one at the public meeting voiced any overall objections to the preferred remedy. However, there were concerns about the cost of the preferred remedy ($5.7 million) and who was going to have to pay for implementation of the remedy. Local officials were concerned about whether adequate notice of the public meeting had been provided to the local community. The public comment period was held from June 15, 1995 through July 14, 1995. MDE submitted written comments on the Proposed Plan; these comments have been addressed in the Responsiveness Summary, which is part of this Record of Decision. No other written comments were received.

X. Selected Remedy

Following review and consideration of the information in the Administrative Record file, the requirements of CERCLA and the NCP, and based on an evaluation of the nine criteria above, EPA has selected Alternative 3 as the remedy for addressing the contamination at this Site. EPA believes that Alternative 3 provides the best balance among the criteria used to evaluate the alternatives. Alternative 3 provides an appropriate level of protection to human health and the environment, satisfies all requirements that are applicable or relevant and appropriate, and is cost-effective. Alternative 3 consists of remedial actions for addressing all of the environmental media of concern at the Site. This remedy is also consistent with EPA's presumptive remedy guidance developed to address remediation at municipal landfill sites.

A. Description of Selected Remedy

The selected remedy consists of the following components:

(1) Single Barrier Cover System

Construction and maintenance of a single barrier cover system shall serve to contain the landfill contents and onsite soils while reducing the amount of leachate produced. Prior to construction, the existing topography shall be regraded to provide a sound foundation for the cover system. The single barrier cover system shall then be constructed over the landfill. The cover system shall meet the applicable substantive requirements for municipal landfill caps identified in Table 28.

(2) Stormwater Control System

A stormwater conveyance system shall be constructed to convey and collect runoff and sediment, to create positive drainage, and to minimize the potential for erosion of the cover system. This conveyance system shall include a perimeter channel and three sedimentation basins. The sedimentation basins shall be designed to meet the relevant and appropriate erosion and sediment control requirements identified in Table 28.

(3) Landfill Gas Management System

A landfill gas management system which includes a vertical gas interceptor (slurry wall), a gas collection layer, and gas venting wells, shall be constructed as part of the selected remedy. This system shall be designed to create a preferential pathway for landfill gas from the gas collection layer to the atmosphere. The goal of the landfill gas management system shall be to direct and/or transport landfill gas away from the residences located to the south of the Site before venting to the atmosphere.

Presently, it is not known whether VOC emissions from the landfill gas collection/venting system will exceed levels that require control under Federal and State applicable or relevant and appropriate requirements identified in Table 28. Air monitoring data at the points of discharge shall be collected, and EPA shall determine if air emission controls are necessary to comply with the Federal and State ARARs. If so, such controls shall be required.

(4) Ground Water Monitoring Program

A long-term monitoring program shall be instituted for the ground water at the Site. This program shall monitor the progress of contaminant degradation to ensure that the concentrations of site-related contaminants are reduced to acceptable levels.

Based on the rate of reduction of organic contaminants in existing monitoring wells over time, it has been estimated that the levels of organic contaminants present in the ground water would be reduced to non-detect levels via natural attenuation in approximately 13 years without the single barrier cover system. It is anticipated that the combination of the single barrier cover system and natural attenuation will accelerate the reduction of the levels of organics in the ground water to acceptable levels in less than 13 years.

With regard to contaminants in the ground water, the risk assessment indicates that the carcinogenic and non-carcinogenic risks associated with exposure to contaminated ground water at the Site exceed acceptable levels. In order to address this unacceptable risk, the selected remedy includes a requirement to monitor the ground water until the concentrations of the Site-related hazardous substances, when considered cumulatively, are reduced to an acceptable risk level (i.e., carcinogenic risk of 1 x 10-6 and a hazard index of less than or equal to 1.0). In addition, for organic compounds a requirement of the selected remedy is achievement of MCLs and non-zero MCLGs in the ground water, and for inorganic compounds, a requirement of the selected remedy is achievement of MCLs and non-zero MCLGs if these values are higher than the established background levels.

There is not sufficient evidence, at this time, to determine whether the elevated levels of inorganic contaminants detected in the ground water are due to background levels or are Site-related. The goal of the selected remedy, specifically the single barrier cover system in conjunction with natural attenuation of contaminants in the ground water, is to reduce the level of inorganic contaminants in the ground water to a level that achieves ARARs and is protective of human health and the environment, given the background levels. In order to attain this standard, the background levels of inorganic contaminants must be established via additional ground water study during remedial design. Once background levels for inorganics are established, a comparison between the background and the onsite (downgradient) wells will be made. If the levels of inorganic contaminants found in the ground water at the Site are greater than the established background levels, this contamination will be considered Site-related. Therefore, the performance standard for inorganic contaminants shall be the risk-based levels discussed above (cumulative carcinogenic risk of 1 x 10-6 and a cumulative hazard index of # 1.0) or the established background level, whichever is higher. Additionally, for inorganic contaminants, the performance standards shall also include achievement of MCLs and non-zero MCLGs if these values are higher than the established background levels.

The ground water monitoring program shall be instituted to evaluate the effectiveness of natural attenuation. Ground-water monitoring shall continue until the concentrations of all hazardous substances that are determined to be Site-related are reduced to an acceptable risk level (i.e., cumulative carcinogenic risk of 1 x 10-6 and a cumulative hazard index of less than or equal to 1.0)15 or to the established background level, whichever is higher. The method for evaluating the cumulative risk for Site-related hazardous substances shall be subject to review and approval by EPA, in consultation with MDE. In addition, ground-water monitoring shall also continue until the concentrations of organic compounds reaches the MCLs and non-zero MCLGs in the ground water and the concentrationm of all inorganic compounds reaches the MCLs and non-zero MCLGs if these values are higher than the established background levels. If the results of the ground water monitoring program suggest that the levels of Site-related hazardous substances are not decreasing, or if the projected time for achieving the established performance standards is extended, EPA may require that additional response actions be taken to address the ground water contamination. Such response actions are not selected in this ROD.

(5) Ecological Monitoring Program

A monitoring program shall be instituted for surface water and sediments from the adjacent streams and wetland area at the Site to ensure that the selected remedy is protective of the environment. If EPA determines that the selected remedy does not provide adequate environmental protection, then additional remedial measures may be required. Such additional remedial measures are not selected in this ROD.

(6) Institutional Controls

Deed restrictions shall be placed on the property where landfill contents remain ("the landfill property") to prohibit (1) any activity that would interfere with the integrity of the remedy, until such time as EPA, in consultation with MDE, determines that such deed restriction is no longer necessary to protect public health and the environment; and (2) the use of ground water under the landfill property for domestic purposes, including drinking water, until such time as EPA decides that adequate data exists to determine that the ground water performance standards have been met. Land use restrictions would also be instituted prohibiting use of ground water for domestic purposes, including drinking water, from under any other land parcels in the area to which contaminated ground water from the landfill property exceeding the 1 x 10-4 risk level has migrated, until such time as EPA decides that enough data exists to determine that the ground water performance standards have been met. These land use restrictions are necessary to ensure that the selected remedy is protective of public health and the environment.

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15 This risk level is consistent with "EPA's preference for setting cleanup levels at the more protective end of the risk range..." 55 Fed. Reg. 8716 (March 8, 1990). EPA considered the factors that allow for revision to a different level within the acceptable risk range but determined that the relevant criteria did not justify such revision. In fact, the fact that some risk may be associated with the background levels of inorganics strengthens EPA's preference for achieving a cleanup level at the more protective end of the risk range.

Access restrictions shall be provided by a perimeter fence and signage.

(7) Operation and Maintenance

Operation and maintenance of the single barrier cover system, the stormwater control system, and the landfill gas management system shall continue until EPA determines that these systems are no longer necessary to assure protection of human health and the environment. At this time, EPA anticipates that such measures will be necessary indefinitely.

B. Performance Standards

(1) Sinqle Barrier Cover System Performance Standards

! A single barrier cover system shall be installed in accordance with the substantive standards of COMAR 26.04.07.21 A, B, D, and E. The cover system shall cover the entire area of solid waste disposal, approximately 16 acres.

! The cover system shall consist of a bedding layer, a gas venting layer, a barrier layer, a drainage layer and a protective layer in conformance with the single barrier cover system specifications presented in the EPA Municipal Landfill Guidance (EPA/540/P-91/001).

! The barrier layer of the cover system shall consist of 24 inches of clay with a permeability less than or equal to 1 10-7 centimeters per second ("cm/sec"), or a synthetic liner that is equally protective, as determined by EPA. The choice of materials for the barrier layer shall be made by EPA, in consultation with MDE, during remedial design.

! All clearing, grading, and excavation activities associated with construction of the cover system shall be conducted in accordance with the substantive standards of COMAR 26.09.01.01, 26.09.01.05 A and B, 26.09.01.07 B, and 26.09.01.08 A and B.

! Maintenance of the cover system shall be performed in accordance with the substantive standards of COMAR 26.04.07.22 A, B, and C, to prevent degradation of the cover system and to ensure long-term effectiveness.

! The vegetative cover on the cover system shall be constructed in accordance with a management plan developed for the purpose of creating and maintaining a grassland or grass/shrub habitat. Consultation with EPA's Biological Technical Assistance Group ("BTAG") shall be necessary during development of this management plan and the plan shall be subject to EPA approval, in consultation with MDE.

(2) Stormwater Control System Peformance Standards

! The sedimentation basins and stormwater control channels shall be constructed to minimize erosion, in accordance with the substantive standards of COMAR 26.09.02.02, 26.09.02.05 A and B, 26.09.02.06 A(2), and 26.09.02.08.

! All clearing, grading, and excavation activities associated with construction of the stormwater control system shall be conducted in accordance with the substantive standards of COMAR 26.09.01.01, 26.09.01.05 A and B, 26.09.01.07 B, and 26.09.01.08 A and B.

(3) Landfill Gas Management System Performance Standards

! The landfill gas management system, once it is installed, shall control landfill gas emissions, in accordance with the substantive standards of COMAR 26.11.06.01, 26.11.06.02, 26.11.06.03, 26.11.06.06, 26.11.06.08, and 26.11.06.09.

! The effectiveness of the landfill gas management system in controlling landfill gas emissions shall be evaluated in accordance with a landfill gas emissions monitoring plan that shall be developed during remedial design. The plan shall include sampling at the landfill gas discharge points and at the Site boundaries for Site-related VOCs. The monitoring plan shall comply with the substantive standards for monitoring contained in the ARARs identified for the landfill gas management system. The landfill gas emissions monitoring plan shall be subject to review and approval by EPA, in consultation with MDE. Landfill gas emissions monitoring shall be conducted semiannually, with the first round immediately following completion of remedial action, and then semiannually thereafter for a period of at least five (5) years.

! The landfill gas vents or any other source of emissions must also comply with the substantive standards of Maryland's Regulations Governing Toxic Air Pollutants, COMAR 26.11.15.

! An active landfill gas management system equipped with RACT shall be required in accordance with the substantive standards of COMAR 26.11.19.01, and 26.11.19.02 G if total VOC emissions from the landfill exceed 25 tons per year.

! If the landfill gas monitoring data indicate that emission standards set forth in COMAR 26.11.06.02, 26.11.06.03, 26.11.06.06, 26.11.06.08, 26.11.06.09, 26.11.19.01, 26.11.19 G, and 26.11.15 are not being met, then, at a minimum, emission controls shall be required, and, in addition, the passive gas collection system shall be converted to an active gas collection system if necessary to meet these emission standards.

! A slurry wall shall be installed to reduce horizontal migration of gasses from the landfill. At a minimum, the slurry wall shall be as deep as the water table and shall be located to the south of the Site between the landfill and adjacent residences. The exact location, depth, and specifications, for the slurry wall shall be developed during remedial design.

(4) Ground-Water Monitoring Performance Standards

! A ground water monitoring system shall be installed to evaluate the degradation of Site-related contaminants and/or the migration of Site-related contaminants beyond the landfill area in accordance with the substantive monitoring requirements of 40 C.F.R. Part 264, Subpart F. The system shall include selected existing wells and, at a minimum, five new wells, the location of which shall be determined during remedial design. All monitoring wells shall be constructed in accordance with the substantive requirements of COMAR 26.04.04.02 and 26.04.04.07. Any wells to be abandoned shall be abandoned in accordance with the substantive requirements of COMAR 26.04.04.11. Newly installed monitoring wells shall be located in the uppermost continuous water-bearing aquifer. A ground water monitoring plan, subject to approval by EPA, in consultation with MDE, shall be developed during remedial design.

! The ground water monitoring system wells shall be sampled in accordance with the substantive monitoring requirements of 40 C.F.R. Part 264, Subpart F on a semi-annual basis for a period of at least two years. Sampling shall begin during the remedial design phase. Following evaluation of the semi-annual sampling results, the scope and frequency for subsequent sampling shall be determined by EPA, in consultation with MDE. Samples shall be analyzed for all EPA Contract Laboratory Program Target Compound List VOCs and Target Analyte List Metals. The ground water monitoring program shall continue until EPA decides that adequate data exists to determine that the Site-related hazardous substances have been reduced to meet the performance standards found in Subsection A(4) of Section X (Selected Remedy).

(5) Ecological Monitoring Program Performance Standards

! The effectiveness of the selected remedy in protecting ecological resources shall be monitored in accordance with an ecological monitoring plan that shall be developed during remedial design. The plan shall include monitoring of the adjacent wetland and stream surface water, sediment, and benthic environments. The plan shall be submitted for review and approval by EPA, in consultation with MDE. Ecological monitoring shall be conducted annually, with the first round prior to the start of remedial action to establish a data baseline, and then annually thereafter for the period determined to be necessary by EPA, in consultation with MDE, which period shall be for at least five (5) years.

! The ecological monitoring activities shall include chemical analysis of surface water and sediments. If analytical results from the surface water and sediment sampling indicate that there may be adverse ecological effects due to Site-related contaminants, then sediment bioassays may be required. Toxicity testing shall be run on the sediment samples, if determined to be necessary by EPA, in consultation with MDE.

! As stated previously in this document, background wetland/marsh samples were not possible due to the fact that the Site is located at the headwaters of the adjacent wetland. Therefore, although not necessarily in a "background" location, an ecological reference station with similar sampling protocols shall be established as part of the ecological monitoring plan. Sampling shall not be conducted after a storm event.

! A minimum of ten (10) sampling stations shall be established for monitoring the wetlands and streams (specifically Bynum Run Creek, the Bush River Tributary, and the Unnamed Tributary).

! Chemical analysis of sediments shall be conducted according to the EPA-approved monitoring plan. Samples shall be split for toxicity testing. Sediment samples shall be collected from areas estimated to have a minimum of 50% fines (percentage of sediments that can pass through a 63 micron sieve).

! Sediment toxicity testing, if determined to be necessary by EPA, in consultation with MDE, shall be conducted according to the EPA-approved monitoring plan. A 30% or greater reduction in survival compared to the control sample shall be considered a significant impact.

(6) Perimeter Fencing

! A chain-link fence shall be constructed around the perimeter of the cover system in order to prevent unauthorized access to the Site. No-trespassing signs shall be posted on this fence.

! The chain-link fence shall have a minimum height of six feet and shall be equipped with locking gates.

! The fence shall be maintained in a manner sufficient to prevent unauthorized access to the Site until such a time as EPA, in consultation with MDE, determines that access restrictions are no longer required. Plans for maintenance of the fence shall be subject to EPA approval, in consultation with MDE.

(7) Operation and Maintenance Performance Standards

! Operation and maintenance of the single barrier cover system, the stormwater management system, the landfill gas management system and the perimeter fencing shall be conducted in accordance with an operation and maintenance plan that shall be subject to review and approval by EPA, in consultation with MDE. The plan shall incorporate all substantive operation and maintenance requirements contained in the ARARs identified for a particular remedial activity.

(8) Investigation-Derived Waste

! Investigation-derived waste which is hazardous waste within the meaning of COMAR 26.13.02 and which is to be disposed of offsite shall comply with the substantive standards of COMAR 26.13.03.05 E while being stored onsite.

EPA may modify or refine the selected remedy during remedial design and construction. Such modifications or refinements, if any, would generally reflect results of the engineering design process. The estimated present worth cost of the selected remedy is $5.7 million. This estimate is comprised of a capital cost of $3.8 million and $1.9 million for 30 years of operation and maintenance.

If EPA, in consultation with MDE, determines that the monitoring data indicates that implementation of the selected remedy has not effectively reduced the contamination of the wetland and stream areas observed during the RI or that the contamination levels have increased since implementation of the selected remedy, additional remedial measures addressing the wetland and stream areas, beyond those contained in this selected remedy, may be required.

A determination of whether the implemented remedy is protective of the environment shall be based on at least two (2) years of ecological monitoring data. This data shall be evaluated by EPA, MDE, and any necessary support agencies, using state of the art risk assessment methods. Decisions regarding the need for any possible additional remediation activities at the Site shall be made by EPA, in consultation with MDE. Nothing in this paragraph limits the authority of EPA, in consultation with MDE, to require additional remedial activities and/or different remedial actions prior to completion of the remedy's implementation.

If the results of the ground water monitoring program suggest that the levels of Site-related contaminants are not decreasing as a result of implementation of the selected remedy, or, if the estimated time period needed to meet the established performance standards via the selected remedy is determined to be longer than expected, EPA may require that additional response actions be taken to address the ground water contamination, beyond those contained in this selected remedy.

XI. Statutory Determinations

EPA's primary responsibility at Superfund sites is to select remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA, 42 U.S.C. § 9621, establishes several other statutory requirements and preferences. These requirements/preferences specify that, when complete, the selected remedial action for a site must comply with applicable or relevant and appropriate requirements established under Federal and State environmental and facility siting laws, unless a statutory waiver is justified. The selected remedy must also be cost-effective and utilize permanent treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute also contains a preference for remedies that employ treatment as a principal element. The following sections discuss how the selected remedy for this Site meets these statutory requirements.

A. Overall Protection of Human Health and the Environment

The baseline risk assessment for the Bush Valley Landfill Site determined that the Site potentially presents an unacceptable risk to future residents in the vicinity of the Site who might use ground water for drinking. Specifically, the risk assessment indicates that the cumulative risk posed by ingestion and inhalation of VOCs in ground water is unacceptable. Furthermore, a number of these contaminants exceed MCLs. Over a lifetime, the total excess cancer risk associated with exposure to contaminated ground water at the Site in Area 1 is 9 x 10-4, and in Area 2 is 3.5 x 10-4, for future residents.

The single barrier cover system would provide protection of human health and the environment by decreasing the infiltration of precipitation through the landfill and thereby curtailing continued degradation of ground water. Protection from exposure of human receptors to the contaminated ground water will be provided through land use and access restrictions. Additionally, it is anticipated that natural attenuation processes will reduce the levels of contaminants in the ground water to acceptable levels in 13 years or less. Protection from exposure of human and environmental receptors via direct contact to the landfill itself, onsite contaminated soils, and leachate, shall be provided through construction, operation and maintenance of the single barrier cover system, and deed restrictions on the landfill property.

If it is determined that the ground water contamination is not being sufficiently reduced or has migrated, then EPA, in consultation with MDE, may require additional ground water remediation activities to ensure protection of human health and the environment.

The short-term threats associated with construction of the selected remedy will be readily controlled and no adverse cross-media impacts are expected as a result of implementation this remedy. The selected remedy is protective of human health and the environment.

During all Site work, Occupational Safety and Health Administration ("OSHA") Standards, set forth at 29 C.F.R. Parts 1904, 1910, and 1926 governing worker safety during hazardous waste operations, shall be met.

B. Compliance with Applicable or Relevant and Appropriate Requirements

Under Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), and EPA guidance, remedial actions at Superfund sites must attain legally applicable or relevant and appropriate Federal and State environmental or facility siting standards, requirements, criteria, and limitations (collectively referred to as ARARs). Applicable requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address hazardous material found at the Site, the remedial action to be implemented at the Site, the location of the Site, or other circumstances at the Site. Relevant and appropriate requirements are those which, while not applicable to the Site, nevertheless address problems or situations sufficiently similar to those encountered at the Site that their use is well-suited to the Site.

The selected remedy will comply with all ARARs. The ARARs are presented below:

1. Chemical-Specific ARARs

! The Safe Drinking Water Act's maximum contaminant level goals ("MCLGs"), 40 C.F.R. §§ 141.50-.51, are relevant and appropriate requirements for those substances, pollutants and contaminants that have a MCLG of greater than zero; provided however, that the MCLGs are not relevant and appropriate for those inorganics for which the background level exceeds the MCLG. The single barrier cover system, in conjunction with natural attenuation processes associated with the ground water contamination, will allow for compliance with these requirements.

! The Safe Drinking Water Act's maximum contaminant levels ("MCLs"), 40 C.F.R. §§ 141.11-.12 and 141.61-.62, are relevant and appropriate requirements for those substances, pollutants and contaminants that have a maximum contaminant level goal ("MCLG") of zero; provided however, that the MCLs are not relevant and appropriate for those inorganics for which the background level exceeds the MCL. The single barrier cover system, in conjunction with natural attenuation processes associated with the ground water contamination, will allow for compliance with these requirements.

! Compliance with the Clean Water Act's Federal Ambient Water Quality Criteria for the Protection of Aquatic Life, 33 U.S.C § 1314; Maryland Surface Water Quality Criteria, COMAR 26.08.02.03; Maryland Toxic Substance Water Quality Criteria, COMAR 26.08.02.03-1; Maryland Numerical Criteria for Toxic Substances, COMAR 26.08.02.03-2; and Maryland Water Quality Criteria Specific to Designated Use Criteria for Use I Waters, COMAR 26.08.02.03-3 A shall be attained via the natural degradation processes of the selected remedy.

2. Action-Specific ARARs

! In accordance with COMAR 26.02.03.03 A, Maximum Allowable Noise Levels shall not be exceeded during construction and operation of the selected remedy, unless the activity in question is subject to an exemption from these Levels pursuant to COMAR 26,02.03.03 B(2). The standards specified in COMAR 26.02.03.03 D(2) and (3) shall apply to sound level meters to be used to determine compliance with the Noise Levels.

! The ground water monitoring component of the selected remedy will comply with the requirements of 40 C.F.R Part 264 Subpart F.

! The Single Barrier Cover System shall be constructed in accordance with the substantive standards of Maryland Sanitary Landfill Closure Regulations, COMAR 26.04.07.21 A, B, D, and E.

! The Single Barrier Cover System shall be maintained in accordance with the substantive standards of Maryland Post-Closure Monitoring and Maintenance Regulations for Sanitary Landfills, COMAR 26.04.07.22 A, B, and C.

! Any land clearing, grading, or excavating performed during the course of the selected remedy shall comply with the substantive standards of Maryland Erosion and Sediment Control Regulations, COMAR 26.09.01.01, 26.09.01.05 A and B, 26.09.01.07 B, and 26.09.01.08 A and B.

! Stormwater shall be managed in accordance with the substantive standards of Maryland Stormwater Management Regulations, COMAR 26.09.02.02, 26.09.02.05 A and B, 26.09.02.06 A(2), and 26.09.02.08.

! Emissions from landfill gas vents shall meet emission limitations in accordance with the substantive standards of Maryland Regulations Governing Air Quality, COMAR 26.11.06.01, 26.11.06.02, 26.11.06.03, 26.11.06.06, 26.11.06.08, and 26.11.06.09. If the emissions from the gas vents exceed these limitations, then additional control measures shall be required as part of this remedy.

! The landfill gas vents or any other source of emissions must also comply with the substantive standards of Maryland's Regulations Governing Toxic Air Pollutants, COMAR 26.11.15.

! An active landfill gas management system equipped with Reasonably Available Control Technology shall be required in accordance with COMAR 26.11.19.02 G if total VOC emissions from the landfill exceed 25 tons per year.

! All monitoring wells shall be constructed in accordance with the substantive requirements of COMAR 26.04.04.02 and 26.04.04.07. Any wells to be abandoned shall be abandoned in accordance with the substantive requirements of COMAR 26.04.04.11

! Investigation-derived waste which is hazardous waste within the meaning of COMAR 26.13.02 and which is to be disposed of offsite shall comply with the substantive standards of COMAR 26.13.03.05 E while being stored onsite.

3. Location-Specific ARARs

! Any remedial activities that may affect the wetlands adjacent to the Site shall comply with the substantive standards of 40 C.F.R. § 6.302(a).

! The substantive standards of 40 C.F.R. § 6.302(b) shall apply to all activities at the Site.

! Any remedial activities that involve construction, reconstruction, dredging, or filling in the tidal wetlands located east of the landfill shall comply with the substantive standards found in COMAR 08.05.05. Any remedial activities that involve: (i) removal, excavation, or dredging of any materials, (ii) changing existing drainage characteristics, sedimentation patterns, flow patterns, or flood retention characteristics, (iii) disturbance of the water level or water table by drainage, impoundment, or other means, (iv) dumping, discharging of, or filling with material, or placing of obstructions, (v) grading or removal of material that would alter existing topography, or (vi) destruction or removal of plant life that would alter the character of a nontidal wetland, shall comply with the substantive requirements of COMAR 08.05.04.

C. Cost-Effectiveness

Section 300.430(f)(1)(ii)(D) of the NCP requires EPA to evaluate cost-effectiveness by first determining if the alternative satisfies the threshold criteria: protection of human health and the environment and compliance with ARARs. The effectiveness of the alternative is then determined by evaluating the following three of the five balancing criteria: long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; and short-term effectiveness. The selected remedy meets these criteria. The selected remedy is cost-effective because the costs are proportional to its overall effectiveness. The estimated present worth cost for the selected remedy is $ 5,700,000.

D. Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

Section 121(b) of CERCLA, 42 U.S.C. § 9621(b), establishes a preference for remedial actions that permanently and significantly reduce toxicity, mobility, or volume of hazardous substances over remedial actions which will not.

This remedy is consistent with the presumptive remedy guidance for municipal landfill sites. When the RI/FS was initiated, it was determined that the presumptive remedy guidance for municipal landfills would be followed. The framework for evaluating a presumptive remedy for municipal landfill sites is presented in a manual entitled Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sitesr February 1991 (OSWER Directive 9355.3-11). This guidance was followed when conducting the RI/FS and evaluating remedial alternatives at this Site. Based on that guidance and the rest of the Administrative Record for this Site, EPA is selecting a remedy for this Site which does not use treatment to permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances at the Site.

E. Preference for Treatment as a Principal Element

Remedial alternatives identified in the presumptive remedy guidance for municipal landfills are appropriate for this Site. Presumptive remedies are preferred technologies for common categories of sites, based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation. The objective of the presumptive remedies initiative is to use the Superfund program's past experience to streamline site investigation and speed up selection of cleanup actions. Over time, presumptive remedies are expected to ensure consistency in remedy selection and reduce the cost and time required to clean up similar types of sites. Presumptive remedies are expected to be used at all appropriate sites except under unusual site-specific circumstances.

The EPA directive, Presumptive Remedy for CERCLA Municipal Landfill Sites, September 1993 (OSWER Directive 9355.0-49), establishes containment as the presumptive remedy for CERCLA municipal landfills; therefore, the selected remedy does not include treatment as a principal element.

PART III- RESPONSIVENESS SUMMARY BUSH VALLEY LANDFILL SUPERFUND SITE

This Responsiveness Summary documents public concerns and comments received by the U.S. Environmental Protection Agency ("EPA") during the public comment period for the Proposed Remedial Action Plan ("PRAP" or "Proposed Plan") for the Bush Valley Landfill Superfund Site ("Site"). Comments were received both verbally at the public meeting held on June 26, 1995 and in writing. This summary also provides EPA's responses to those comments. The information is organized as follows:

I. Overview

II. Summary of comments received during the June 26, 1995, public meeting and EPA responses

III. Summary of written comments received during the comment period and EPA responses

I. Overview

A public comment period was held from June 15, 1995 through July 14, 1995 to receive comments from the public on the Remedial Investigation and Feasibility Study ("RI/FS") Reports, the Proposed Plan, the preferred alternative, and the remaining remedial alternatives outlined in the Proposed Plan. A public meeting was held on June 26, 1995 at 7:00 pm at the Edgewood High School, in Edgewood, Maryland. The public meeting was attended by EPA and Maryland Department of the Environment ("MDE") staff, representatives from Harford County, local elected officials, and local residents. The transcript of the public meeting is contained in the Administrative Record for the Site.

The public meeting was preceded by a briefing of the local elected official from the County District where the Site is located. This briefing was held at 3:30 pm at the Harford County Offices in Bel Air, Maryland. The briefing was attended by EPA and MDE staff, a representative from Harford County Department of Public Works, the County Attorney, and a member of the Harford County Council.

Comments received during the public comment period are presented below with a response to each.

II. Summary of Comments Received during the June 26, 1995 Public Meeting and EPA Responses

Significant questions and comments presented at the June 26, 1995, public meeting are listed and/or summarized briefly in this section. The EPA response follows each of the questions or comments presented.

Comment 1: One commenter asked what basic contaminants EPA would be looking at.

EPA Response: The medium of greatest concern at the Site is the ground water. The major contaminants of concern in the ground water are Volatile Organic Compounds ("VOCs"). There are some elevated levels of inorganic contaminants (heavy metals) in the ground water, but there is no clear pattern to the metals contamination. EPA has concluded that, although inorganics are present, it is not clear at this time that they are Site-related. With regard to contaminants in the ground water, the baseline risk assessment indicates that the carcinogenic and non-carcinogenic risks associated with exposure to contaminated ground water at the Site exceed acceptable levels. In order to address this unacceptable risk, the selected remedy includes a requirement to monitor the ground water until the concentrations of the Site-related contaminants of concern, when considered cumulatively, are reduced to an acceptable risk level (i.e. carcinogenic risk of 1×10^{-6} and a hazard index of less than or equal to 1.0). In addition, for organic compounds a requirement of the selected remedy is achievement of Maximum Contaminant Levels ("MCLs") and non-zero Maximum Contaminant Level Goals ("MCLGs")[1] in the ground water and for inorganic compounds a requirement of the selected remedy is achievement of MCLs and non-zero MCLGs if these values are higher than the established background levels.

Comment 2: One commenter wanted to know how many test wells were present at the Site and if EPA had obtained "positive readings" at all locations.

EPA Response: There are eleven (11) monitoring wells at the Site. Four of these wells are considered to be upgradient. Also, three residential wells were sampled during the Remedial Investigation ("RI").

Both Organic and inorganic (heavy metals) contaminants were detected in the monitoring wells; however, only organic contaminants (VOCs) were consistently detected above drinking water standards, specifically MCLs. Two heavy metals, nickel and cadmium, were detected above MCLs in two monitoring wells; however, these wells are located upgradient from the Site and these contaminants are not considered to be Site-related. Only inorganic contaminants were detected in the residential wells, and these inorganics were present at levels that are below their respective MCLs.

1 Maximum Contaminant Levels and Maximum Contaminant Level Goals are contaminant-specific drinking water standards established under the Federal Safe Drinking Water Act that are applicable to certain public water suppliers.

Comment 3: One commenter asked about the proposed landfill gas management system and what type of treatment would be used, if necessary. She specifically asked if EPA would be using flares for gas treatment.

EPA Response: The landfill gas management system is made up of a number of components including: the gas collection layer (sand layer) which is part of the single barrier cover system, a slurry wall, and gas venting wells. The landfill gases will be blocked by the slurry wall to the south of the landfill and channeled to specific points of discharge at the northern portion of the landfill. The discharge points will be monitored to determine if federal and State landfill gas emission standards are being met. If these standards are not being met, then the gases will be treated. The use of flares for treatment may be appropriate.

Comment 4: The same commenter then asked what a "slurry wall" was.

EPA Response: A slurry wall is a vertical barrier which is constructed by digging a trench, usually down to the water table, between a waste source and a receptor. This trench is then filled with a low permeability substance (in slurry form), usually a bentonite mixture. At this Site, the slurry wall would prevent the landfill gases from migrating toward the residences to the south of the Site.

Comment 5: The same commenter then asked how deep the water table was at this Site.

EPA Response: Although the response given at the public meeting was that the water table is 7 feet deep, the water table is actually encountered at a depth of approximately 30 feet.

Comment 6: One commenter wanted to know why EPA did not evaluate an entire range of alternatives for this Site.

EPA Response: During the early stages of the project, it was determined that the presumptive remedy for municipal landfills would be appropriate for this Site. Accordingly, the following documents were used to guide EPA's investigation and identification of remedial alternatives: Presumptive Remedy for CERCLA Municipal Landfill Sites,, September 1993 (OSWER Directive 9355.0-49) and Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, February 1991 (OSWER Directive 9355.3-11). The presumptive remedy approach relies on information that has been gained from investigations at similar municipal landfill sites around the country. As a result, only alternatives that have been successful at other similar sites are evaluated. This approach has been shown to save time and money during the RI/FS process.

Comment 7: The same commenter wanted to know specifically why EPA didn't consider excavation and offsite treatment for the waste at this Site and what that kind of alternative would have cost.

EPA Responses: As stated above, EPA applied the presumptive remedy guidance to the Site. The cost of excavating, treating and disposing of the contents of an entire landfill would be prohibitively expensive. Excavation of specific sources of hazardous substances in a landfill may be an appropriate remedy when such sources have been identified. No discrete sources of contamination within the landfill were found at this Site. Therefore, EPA could not justify the cost of excavation especially when (1) there is no current risk posed by the landfill and (2) the landfill can be effectively contained with a cap. The actual cost of excavating this landfill was not calculated; however, based on the costs associated with excavation and offsite treatment at other Superfund Sites, it certainly would be substantially greater than the cost of the selected remedy ($5.7 million).

Comment 8: One commenter wanted to know the breakdown of capital costs and operating costs for the selected remedy.

EPA Response: The capital cost for the selected remedy is $3.8 million and the present worth cost for operation and maintenance of the selected remedy over the next 30 years is $1.9 million.

Comment 9: One commenter made the following remark: "Of course, all of this is going to be paid by the County."

EPA Response: Harford County is currently the only party that has entered into an agreement with EPA to do work at this Site, specifically the RI/FS. However, a number of other potentially responsible parties have been identified for the Site. Following issuance of this Record of Decision ("ROD"), EPA will give all of the potentially responsible parties, including the County, the opportunity to negotiate a Consent Decree with

EPA for the Remedial Design/Remedial Action ("RD/RA").

Comment 10: County Council Member Mitch Shank wanted to know how the citizens that were present had found out about the public meeting. The response was that they had been notified of it in The Aegis. Mr. Shank then indicated that he was concerned that the people from Philadelphia Station, Harford Town Community, etc. may not have had the opportunity to see EPA's ad in The Aegis. He then wanted to know if this was the only scheduled meeting for this Site.

EPA Response: In addition to running an ad in The Aegis, EPA also ran an ad in The Record. However, The Aegis has a general circulation of 35,000 persons throughout Harford County. There are people living in the Philadelphia Station area and Harford Town Community who do subscribe to this newspaper and it is available at local Harford County newsstands and stores. At the public meeting, EPA representatives indicated that, following the meeting, Mr. Shank would be contacted for names and numbers of the local homeowners associations so that EPA could notify them and determine if they were interested in receiving information on the Site. EPA then indicated that if there was public interest in the issue, a public availability session could be held where EPA staff would respond to questions regarding the Site. Although EPA called Mr. Shank a number of times, EPA was unable to get further information regarding parties that may have been interested in additional information and did not schedule an availability session.

III. Summary of Written Comments Received during the Public Comment Period and EPA Responses

The only written comments on the Proposed Plan received during the public comment period were from the Maryland Department of the Environment ("MDE"). MDE's significant comments are summarized below along with EPA's responses.

Comment 1: A number of MDE's comments requested language changes to the Proposed Plan.

EPA Response: The Proposed Plan was issued on June 15, 1995 as a final document.

Comment 2: MDE asked for documentation of statements made in the Proposed Plan regarding natural attenuation of the ground water -- specifically, the statement that "[i]t is anticipated that the combination of the single barrier cover system and natural attenuation will accelerate the reduction of the levels of organics in the ground water to acceptable levels in less than 13 years."

EPA Response: This documentation can be found in the Administrative Record file in a memo from Barbara Rudnick, EPA geologist, to Melissa Whittington, EPA Remedial Project Manager, dated 6/1/95.

Based on contaminant reductions seen in historical ground-water sampling data, the natural attenuation rate of organic contamination was calculated. These calculations did not take the potential effects of the single barrier cover system into account (which should shorten the attenuation period). For most of the contaminants, it was calculated that reduction of contaminants to undetectable levels would occur within 5 years; however, one contaminant (1,2-dichloroethane), was estimated to take 13.1 years. Considering that the Performance Standards for ground water are higher than non-detect and that the single barrier cover system will accelerate the contaminant reduction due to natural attenuation, it is anticipated that the contaminants in the ground water will meet the designated performance standards in less than 13 years.

Comment 3: The description of the preferred remedy in the Proposed Plan indicated that the material used for the barrier layer of the single barrier cover system could be either clay or a synthetic membrane as long as it had a maximum permeability of 1 x 10-7 cm/sec. The permeability factor is acceptable to MDE; however, MDE recommends the use of a synthetic membrane as opposed to a clay layer.

EPA Response: The decision regarding what materials will be used during construction will be made during the Remedial Design phase of the project. MDE's preference for a synthetic membrane has been noted and MDE is encouraged to comment on the Remedial Design work plan documents.

APPENDIX I

FIGURES

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APPENDIX II

TABLES

Occurrence Summary for Constituents Detected in Leachate Seep-Water Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	Surface-Water Criteria [a]
VOCs						
1,2-Dichlorobenzene	1 / 6	0.005	0.005 - 0.005	0.0050	0.0050	0.763 [b]
1,4-Dichlorobenzene	3 / 6	0.002 - 0.006	0.002 - 0.006	0.0050	0.0063	0.763 [b]
Toluene	1 / 6	0.002	0.002 - 0.002	0.0020	0.0020	NA
Semi-VOCs						
Diethylphthalate	5 / 6	0.001 - 0.004	0.001 - 0.004	0.0027	0.0037	NA
2,4-Dimethylphenol	1 / 6	0.004	0.004 - 0.004	0.0040	0.0040	NA
2-Methylnapthalene	1 / 6	0.002	0.002 - 0.002	0.0020	0.0020	NA
4-Methylphenol	1 / 6	0.004	0.004 - 0.004	0.0040	0.0040	NA
Naphthalene	3 / 5	0.002 - 0.009	0.002 - 0.009	0.0052	0.0076	0.96 [b]
PCBs/Pesticides						
gamma-BHC	1 / 6	0.000004	0.000004 - 0.000004	0.0000040	0.0000040	0.00008 [c]
Heptachlor	1 / 6	0.000056	0.000025 - 0.000056	0.000030	0.000041	0.0000038 [c]
Inorganic (total)						
Aluminum	5 / 6	0.301 - 179	0.02745 - 179	47	110	0.087 [b]
Barium	6 / 6	0.0686 - 6.88	0.0686 - 6.88	1.4	3.6	NA
Cadmium	1 / 6	0.0062	0.0015 - 0.0062	0.0023	0.0039	0.001
Calcium	6 / 6	102 - 332	102 - 332	180	250	NA
Chromium	5 / 6	0.0066 - 0.669	0.003 - 0.669	0.15	0.37	0.21 (0.011)
Cobalt	5 / 6	0.0098 - 0.248	0.004 - 0.248	0.058	0.14	NA
Copper	4 / 6	0.0078 - 0.244	0.0025 - 0.244	0.084	0.17	0.012
Iron	6 / 6	2.88 - 1,340	2.88 - 1,340	330	760	1.0 [c]
Lead	4 / 6	0.0039 - 0.215	0.001 - 0.215	0.058	0.13	0.0032
Magnesium	6 / 6	19.4 - 80.4	19.4 - 80.4	46	68	NA
Manganese	6 / 6	0.513 - 10.7	0.513 - 10.7	3.0	6.2	NA
Mercury	1 / 6	0.00022	0.00005 - 0.00022	0.000078	0.00014	0.000012
Nickel	6 / 6	0.0118 - 0.347	0.0118 - 0.347	0.090	0.20	0.16
Potasium	6 / 6	10.7 - 99	10.7 - 99	47	79	NA
Silver	1 / 6	0.0053	0.002 - 0.0053	0.0026	0.0037	0.00012
Soilium	6 / 6	24.6 - 360	24.6 - 360	130	240	NA
Vanadium	4 / 6	0.0109 - 0.421	0.0015 - 0.421	0.13	0.28	NA
Zinc	4 / 6	0.0761 - 1.25	0.02095 - 1.25	0.36	0.77	0.11

Footnotes appear on page 2.

TABLE 1

Occurrence Summary for Constituents Detected in Leachate Seep-Water Samples, Bush Valley Landfill, Harford County, Maryland.

Concentrations are reported in milligrams per liter (mg/L).

[a]	Maryland Chronic Toxic Substances Criteria for the protection of freshwater aquatic life (COMAR, 26.08.02, Water Quality, [1992], unless specified otherwise.
[b]	No Maryland Surface-Water Quality Criteria available. Value presented is the Federal Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic life via chronic exposure (USEPA, 1986).
[c]	No Marlyand Surface-Water Quality Criteria available. Value presented is the Federal Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic life via chronic exposure (USEPA, 1992).

Mean	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA	Not available.
Total range	All values used in the mean UCL calculations, including proxy concentrations for non-detects.
UCL	95 percent upper confidence limit(one-tailed) on the mean, assuming a normal distribution.

Occurrence Summary for Constituents Detected in Leachate Seep-Water Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	NOAA ER-L	NOOA ER-M	Upgradient Range [a] Min - Max
VOCs								
Acetone	1 / 8	0.49	0.005 - 0.49	0.067	0.18	NA	NA	<0.012 - 0.022
Benzene	1 / 8	0.003	0.003 - 0.003	0.003	0.003	NA	NA	<0.012 - 0.005
2-Butanone	2 / 8	0.072 - 0.078	0.005 - 0.078	0.023	0.045	NA	NA	<0.012 - 0.025
Carbon disulfide	2 / 8	0.004 - 0.014	0.004 - 0.014	0.0055	0.0078	NA	NA	<0.012 - 0.005
1,1-Dichloroethane	1 / 8	0.004	0.004 - 0.004	0.004	0.004	NA	NA	<0.012 - <0.014
Methylene chloride	1 / 8	0.007	0.002 - 0.007	0.0034	0.0046	NA	NA	<0.004 - <0.011
Toluene	3 / 8	0.003 - 0.012	0.003 - 0.012	0.006	0.0078	NA	NA	<0.012 - 0.003
Trichloroethene	1 / 8	0.004	0.004 - 0.004	0.004	0.004	NA	NA	<0.012 - <0.014
Semi-VOCs								
Di-n-butylphthalate	1 / 8	0.19	0.19 - 0.19	0.19	0.19	NA	NA	<0.4 - <0.47
PCBs								
Aroclor-1254	7 / 8	0.019 - 0.25	0.0125 - 0.25	0.053	0.11	0.050	0.40	0.029 - 0.15
Inorganics								
Aluminum	8 / 8	3,380 - 9,200	3,380 - 9,200	6,000	7,300	NA	NA	944 - 11,500
Arsenic	1 / 8	1.7	0.245 - 1.7	0.53	0.9	33	85	0.63 - 13.4
Barium	8 / 8	10.7 - 55.7	10.7 - 55.7	31	42	NA	NA	6.3 - 70.3
Beryllium	8 / 8	0.27 - 1.0	0.27 - 1.0	0.53	0.71	NA	NA	0.26 - 1.5
Boron	1 / 8	2.5	0.9 - 2.5	1.2	1.5	NA	NA	<1.9 - 2.4
Cadmium	3 / 8	3.1 - 8.6	0.55 - 8.6	2.5	4.4	5	9	<1.2 - <1.4
Calcium	8 / 8	106 - 1,510	106 - 1,510	660	980	NA	NA	88.4 - 1,510
Chromium	8 / 8	11 - 28	11 - 28	21	25	80	145	16.7 - 54.6
Cobalt	8 / 8	3.9 - 30.6	3.9 - 30.6	10	16	NA	NA	5.4 - 182
Copper	8 / 8	6.1 - 22.4	6.1 - 22.4	11	15	70	390	7.5 - 56.6
Iron	8 / 8	4,060 - 13,400	4,060 - 13,400	7,800	9,900	NA	NA	3,910 - 44.200
Lead	8 / 8	1.2 - 4.6	1.2 - 4.6	2.7	3.5	35	110	2.7 - 15.3

Footnotes appear on page 2.

Occurrence Summary for Constituents Detected in Leachate Seep-Water Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	NOAA ER-L	NOOA ER-M	Upgradient Range [a] Min - Max
Inorganics (Continued)								
Magnesium	8 / 8	560 - 3,180	560 - 3,180	1,400	2,000	NA	NA	74.2 - 1,990
Manganese	8 / 8	33.5 - 300	33.5 - 300	110	180	NA	NA	10.2 - 200
Mercury	1 / 8	0.18	0.05 - 0.18	0.074	0.1	0.15	1.3	<0.11 - 0.17
Nickel	8 / 8	4.5 - 17.6	4.5 - 17.6	10	13	30	50	4.2 - 178
Potassium	8 / 8	171 - 629	171 - 629	430	550	NA	NA	412 - 615
Silver	1 / 8	1.5	0.7 - 1.5	0.86	1.0	1	2.2	<1.4 - <1.7
Sodium	8 / 8	47.2 - 1,540	47.2 - 1,540	510	900	NA	NA	60.4 - 297
Tin	8 / 8	43.9 - 99.6	43.9 - 99.6	80	92	NA	NA	42.8 - 85
Vanadium	8 / 8	12.5 - 43.9	12.5 - 43.9	28	36	NA	NA	27.6 - 60.1
Zinc	8 / 8	10.6 - 65.7	10.6 - 65.7	33	46	120	270	8.2 - 238

Concentration are reported in milligrams per kilogram (mg/kg).

Subsurface soil samples include GM3, GM4LSS, GM4LSD, GM5, GM6, GM8, GM2LSS, and GM2LSD collected at depths ranging from 7 to 34 feet below land surface.

[a] Range of concentrations in upgradient samples GMIUS, GMILSS, GM-7, and GM-9 collected at depths ranging from 10 to 40 feet below land surface.

ER-L Effects range-low (NOAA, 1990).
ER-M Effects range-median (NOAA, 1990).
Mean Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA Not available.
NOAA National Oceanic and Atmospheric Administration.
PCBs Polychlorinated biphenols.
Total range All values used in the mean and UCL calculation including proxy concentrations for non-detects.
UCL 95 percent confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOCs Volatile organic compounds.

TABLE 2
(continued)

Occurrence Summary for Constituents Detected in Upgradient Groundwater Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	MCL
VOCs						
Benzene	1 / 8	0.003	0.003 - 0.003	0.0030	0.0030	0.005 [a]
Bromomethane	1 / 8	0.005	0.005 - 0.005	0.0050	0.0050	NA
1,1-Dichloroethane	1 / 8	0.003	0.003 - 0.003	0.0030	0.0030	NA
Tetrachloroethene	2 / 8	0.03 - 0.034	0.005 - 0.034	0.012	0.020	0.005 [b]
Toluene	1 / 8	0.003	0.003 - 0.003	0.0030	0.0030	1.0 [b]
1,1,1-Trichloroethane	1 / 8	0.004	0.004 - 0.004	0.0040	0.0040	0.2 [a]
Trichloroethene	1 / 8	0.011	0.004 - 0.011	0.0064	0.0082	0.005 [b]
Pesticides						
alpha-BHC	1 / 8	0.0000041	0.0000041 - 0.0000041	0.0000041	0.0000041	0.0002 [b]
Inorganice (Total)						
Aluminum	7 / 8	0.12 - 1.43	0.058 - 1.43	0.65	1.0	0.05 - 0.2 [c]
Barium	8 / 8	0.0212 - 0.0733	0.0212 - 0.0733	0.052	0.065	1 [a]
Beryllium	3 / 8	0.0012 - 0.0021	0.0005 - 0.0021	0.00091	0.0013	0.004 [b]
Cadmium	1 / 8	0.0105	0.0015 - 0.0105	0.0031	0.0051	0.005 [b]
Calcium	8 / 8	2.45 - 61.4	2.45 - 61.4	22	39	NA
Chromium	1 / 8	0.0088	0.004 - 0.0088	0.0051	0.0062	0.05 [a]
Cobalt	6 / 8	0.0124 - 0.452	0.0035 - 0.452	0.15	0.26	NA
Copper	4 / 8	0.0087 - 0.0122	0.0035 - 0.0122	0.0077	0.010	1.3 [d]
Iron	8 / 8	0.526 - 28.2	0.526 - 28.2	7.8	15	0.3 [c]
Magnesium	8 / 8	1.26 - 27.1	1.26 - 27.1	10	17	NA
Manganese	8 / 8	0.0237 - 4.27	0.0237 - 4.27	1.9	3.2	0.2 [d]
Nickel	6 / 8	0.0374 - 0.789	0.0035 - 0.789	0.25	0.45	0.1 [b]
Potassium	8 / 8	0.678 - 8.84	0.678 - 8.84	4.3	6.9	NA
Sodium	8 / 8	5.67 - 118	5.67 - 118	37	69	NA
Vanadium	1 / 8	0.012	0.003 - 0.012	0.0047	0.0067	NA
Zinc	4 / 8	0.234 - 0.347	0.0015 - 0.347	0.15	0.25	5 [c]

Footnotes appear on page 2.

TABLE 3

Occurrence Summary for Constituents Detected in Upgradient Groundwater Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	MCL
Inorganic (Dissolved)						
Aluminum	1 / 7	0.0722	0.0305 - 0.0722	0.052	0.064	0.05 - 0.2 [c]
Barium	7 / 7	0.018 - 0.0741	0.018 - 0.0741	0.052	0.064	1 [a]
Beryllium	2 / 7	0.001 - 0.0019	0.0005 - 00019	0.00077	0.0012	0.004 [b]
Calcium	7 / 7	3.37 - 60.5	3.37 - 60.5	25	42	NA
Cobalt	4 / 7	0.0152 - 0.487	0.0035 - 0.487	0.15	0.27	NA
Iron	7 / 7	0.164 - 25.2	0.164 - 25.2	7.2	15	0.3 [c]
Magnesium	7 / 7	1.39 - 29.7	1.39 - 29.7	12	20	NA
Manganese	7 / 7	0.0297 - 4.41	0.0297 - 4.41	2.2	3.7	0.2 [d]
Mercury	1 / 7	0.00049	0.0001 - 0.00049	0.00016	0.00026	0.002 [b]
Nickel	5 / 7	0.0438 - 0.846	0.0035 - 0.846	0.31	0.56	0.1 [b]
Potassium	7 / 7	0.659 - 9.12	0.659 - 9.12	4.3	6.9	NA
Sodium	7 / 7	6.13 - 123	6.13 - 123	45	84	NA
Zinc	4 / 7	0.0253 - 0.408	0.001 - 0.408	0.17	0.29	5 [c]

Concentration are reported in milligrams per liter (mg/L).

Upgradient groundwater samples include GM1US, GM1LSS, GM7, and GM9.

[a] State MCL (Code of Maryland Regulations [COMAR] 26.08.02. Water Quality, 1991).
[b] Federal MCL (USEPA, 1992a).
[c] Secondary MCL (USEPA, 1992a).
[d] Maximum contaminant level goal (USEPA, 1992a).

MCL Maximum contaminant level.
Mean Arithmetic average of the total number of sample, using proxy concentrations for non-detects.
NA Not available.
Total range All values used in the mean and UCL calculations, including proxy concentrations for non-detects.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOCs Volatile organic compounds.

TABLE 3
(continued)

TABLE 4 - SEE PAGE 11 OF
DECISION SUMMARY

Occurrence Summary for Constituents Detected in Leachate Seep-Water Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	MCL	Upgradient Range [a] Min - Max
VOCs							
Benzene	6 / 19	0.003 - 0.007	0.001 - 0.007	0.0042	0.0047	0.005 [b]	<0.010 - 0.003
Chlorobenzene	5 / 19	0.004 - 0.008	0.0015 - 0.008	0.0053	0.0058	NA	<0.010
Chloroethane	4 / 19	0.006 - 0.013	0.005 - 0.013	0.0061	0.007	NA	<0.010
1,4-Dichlorobenzene	7 / 19	0.002 - 0.009	0.002 - 0.009	0.0049	0.0056	0.075 [c]	<0.010
1,1-Dichloroethane	9 / 19	0.003 - 0.049	0.003 - 0.049	0.010	0.015	NA	<0.010 - 0.003
1,2-Dichloroelhane	12 / 19	0.001 - 0.14	0003 - 0.14	0.026	0.040	0.005 [c]	<0.010
1,2 Dichloroethene (Total)	5 / 19	0.003 - 0.008	0.003 - 0.008	0.0049	0.0053	0.07 [c,d]	<0.010
1,2 Dichloropropane	6 / 19	0.006 - 0.014	0.005 - 0.014	0.0062	0.0071	0.005 [c]	<0.010
Tetrachloroethene	6 / 19	0.014 - 0.056	0.005 - 0.056	0.012	0.017	0.005 [c]	0.03 - 0.034
Trichloroethene	5 / 19	0.003 - 0.052	0.002 - 0.052	0.0095	0.014	0.005 [c]	<0.008 - 0011
Vinyl chloride	6 / 19	0.003 - 0.013	0.003 - 0.013	0.0063	0.0074	0.002 [c]	<0.010
Pesticides							
alpha-BHC	1 / 19	0.000012	0.000012 - 0.000012	0.000012	0.000012	0.0002 [c]	<0.00005 - 0.0000041
Inorganic (Total)							
Aluminum	18 / 19	0.159 - 3.83	0.0305 - 3.83	1.0	1.5	0.05 - 0.2 [c]	0.12 - 1.43
Arsenic	3 / 19	0.0032 - 0.0042	0.001 - 0.0042	0.0018	0.0022	0.05 [b]	<0.003
Barium	19 / 19	0.0181 - 0.173	0.0181 - 0.173	0.086	0.10	1 [b]	0.0212 - 0.0733
Beryllium	5 / 19	0.0012 - 0.0033	0.0005 - 0.0033	0.00097	0.0013	0.004 [c]	0.0012 - 0.0021
Calcium	19 / 19	5.3 - 37.7	5.3 - 37.7	21	25	NA	2.45 - 61.4
Chromium	4 / 19	0.0084 - 0.0239	0.003 - 0.0239	0.0065	0.0085	0.05 [b]	0.0088 - 0.0088
Cobalt	15 / 19	0.0145 - 0.187	0.0035 - 0.187	0.064	0.085	NA	0.0124 - 0.452
Copper	11 / 19	0.0069 - 0.0183	0.0025 - 0.0183	0.0074	0.0092	1.3 [f]	0.0087 - 0.0122
Iron	18 / 19	0.192 - 105	0.0695 - 105	32	46	0.3 [c]	0.526 - 28.2
Lead	1 / 19	0.0025	0.0005 - 0.0025	0.0015	0.0018	0.015 [g]	<0.001 - <0.0028
Magnesium	19 / 19	1.52 - 21.3	1.52 - 21.3	11	14	NA	1.26 - 27.1
Manganese	19 / 19	0.0512 - 8.62	0.0512 - 8.62	2.6	3.6	0.2 [f]	0.0257 - 4.27
Nickel	9 / 19	0.01 - 0.0548	0.0035 - 0.0548	0.014	0.020	0.1 [c]	0.0374 - 0.789
Potassium	19 / 19	0.858 - 7.85	0.858 - 7.85	2.4	3.1	NA	0.678 - 8.84
Sodium	19 / 19	5.6 - 44.5	5.6 - 44.5	24	30	NA	5.67 - 118
Vanadium	4 / 19	0.0103 - 0.0164	0.0015 - 0.0164	0.0053	0.0070	NA	<0.006 - 0.012
Zinc	4 / 19	0.0326 - 0.349	0.0015 - 0.349	0.038	0.069	5 [e]	0.234 - 0.347

TABLE 5

Occurrence Summary for Constituents Detected in Residential Well #1 Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	MCL	Upgradient Range [a] Min - Max
Pesiticides							
alpha-BHC	1 / 2	0.000004	0.000004 - 0.000004	0.0000040	0.0000040	0.0002 [b]	<0.00005 - 0.0000041
Inorganic (Total)							
Aluminum	2 / 2	0.16 - 0.267	0.16 - 0.267	0.21	0.55	0.05 - 0.2 [c]	0.12 - 1.43
Barium	2 / 2	0.017 - 0.0182	0.0166 - 0.0182	0.017	0.022	1 [d]	0.0212 - 0.0733
Calcium	2 / 2	4.59 - 5.6	4.59 - 5.6	5.1	8.3	NA	2.45 - 61.4
Iron	2 / 2	0.713 - 0.909	0.713 - 0.909	0.81	1.4	0.3 [c]	0.326 - 28.2
Magnesium	2 / 2	2.69 - 2.73	2.69 - 2.73	2.7	2.8	NA	1.26 - 27.1
Manganese	2 / 2	0.09 - 0.111	0.0897 - 0.111	0.10	0.17	0.2 [cI	0.0257 - 4.27
Nickel	1 / 2	0.0123	0.007 - 0.0123	0.0097	0.026	0.1 [b]	0.0374 - 0.789
Potassium	2 / 2	0.365 - 0.427	0.365 - 0.427	0.40	0.59	NA	0.678 - 8.84
Sodium	2 / 2	11.3 - 12.2	11.3 - 12.2	12	15	NA	5.67 - 118

Concentrations are reported in milligrams per liter (mg/L).

[a] Range of detected concentrations in upgradient groundwater samples GM1US, GM1LSS, GM7, and GM9. If the constituent was not detected in the upgradient samples, the lowest detection limit is reported.
[b] Federal MCL (USEPA, 1992a).
[c] Secondary MCL (USEPA, 1992a).
[d] State MCL (Code of Maryland Regulations [COMAR] 26.08.02. Water Quality, 1991).
[e] Maximum contaminant level goal (USEPA, 1992a).

MCL Maximum contaminanl level.
Mean Arithmetic average of the total number of sample, using proxy concentrations for non-detects.
NA Not available.
Total range All values used in the mean and UCL calculations, including proxy concentrations for non-detects.
UCL 95 percent upper confidence limit (one-tailed) on tho mean, assuming a normal distribution.

TABLE 6

Occurrence Summary for Constituents Detected in Residential Well #2 Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	MCL	Upgradient Range [a] Min - Max
Inorganic (Total)							
Barium	2 / 2	0.0108 - 0.0181	0.0108 - 0.0181	0.014	0.037	1 [b]	0.0212 - 0.0733
Calcium	2 / 2	1.3 - 3.64	1.3 - 3.64	2.5	9.9	NA	2.45 - 61.4
Cobalt	1 / 2	0.0083	0.007 - 0.0083	0.0077	0.012	NA	0.0124 - 0.452
Copper	1 / 2	0.012	0.0069 - 0.012	0.0095	0.026	1.3 [c]	0.0087 - 0.0122
Iron	1 / 2	0.0986	0.0525 - 0.0986	0.076	0.22	0.3 [d]	0.526 - 28.2
Magnesium	2 / 2	0.957 - 2.12	0.957 - 2.12	1.5	5.2	NA	1.26 - 27.1
Manganese	2 / 2	0.0065 - 0.0232	0.0065 - 0.0232	0.015	0.068	0.2 [c]	0.0257 - 4.27
Mercury	1 / 2	0.00034	0.0001 - 0.00034	0.00022	0.00098	0.002 [e]	<.0.0002
Nickel	1 / 2	0.0239	0.007 - 0.0239	0.015	0.069	0.1 [e]	0.0374 - 0.789
Potassium	2 / 2	0.288 - 0.394	0.288 - 0.394	0.34	0.68	NA	0.678 - 8.84
Sodium	2 / 2	3.92 - 7.39	3.92 - 7.39	5.7	17	NA	5.67 - 118
Zinc	1 / 2	0.0205	0.00215 - 0.0205	0.011	0.069	5 [d]	0.234 - 0347

Concentrations are reported in milligram per liter (ms/L).

[a] Range of detected concentrations in upgradient groundwater samples GM1US, GM1LSS, GM7, and GM9. If the constituent was not detected in the upgradient samples, the lowest detection limit is reported.
[b] State MCL (Code of Maryland Regulations [COMAR] 26.08.02. Water Quality, 1991).
[c] Maximum contaminant level goal (USEPA, 1992a).
[d] Secondary MCL *USEPA, 1992a).
[e] Federal MCL (USEPA, 1992a).

MCL Maximum contaminanl level.
Mean Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA Not available.
Total range All values used in the mean and UCL calculations, including proxy concentrations for non-detects.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 7

Occurrence Summary for Constituents Detected in Residential Well #3 Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	MCL	Upgradient Range [a] Min - Max
Inorganic (Total)							
Barium	2 / 2	0.0101 - 0.0163	0.0101 - 0.0163	0.013	0.033	1 [b]	0.021 - 0.0733
Calcium	2 / 2	1.43 - 3.02	1.43 - 3.02	2.2	7.2	NA	2.45 - 61.4
Copper	1 / 2	00084	0.0084 - 0.0084	0.0084	0.0084	1.3 [c]	0.0087 - 0.0122
Iron	2 / 2	0.112 - 0.141	0112 - 0.141	0.13	0.22	0.3 [d]	0.526 - 28.2
Magnesium	2 / 2	0.986 - 1.96	0.986 - 1.96	1.5	4.5	NA	1.26 - 27.1
Manganese	2 / 2	0.0042 - 0.0222	0.0042 - 0.0222	0.013	0.070	0.2 [c]	0.0257 - 4.27
Mercury	1 / 2	0.00034	0.0001 - 0.00034	0.00022	0.00098	0.002 [e]	<0.0002
Nickel	1 / 2	0.0198	0.0035 - 0.0198	0.012	0.063	0.1 [e]	0.0374 - 0.789
Potassium	2 / 2	0.327 - 0.344	0.327 - 0.344	0.34	0.39	NA	0678 - 8.84
Sodium	2 / 2	4.06 - 6.7	4.06 - 6.7	5.4	14	NA	5.67 - 118
Zinc	1 / 2	0.0193	0.0018 - 0.0193	0.011	0.066	5 [d]	0.234 - 0.347

Concentrations are reported in milligrams per liter (mg/L)

[a] Range of detected concentrations in upgradient groundwater samples GM1US, GM1LSS, GM7, and GM9. If the constituent was not detected in the upgradient samples, the lowest detection limit is reported.
[b] Federal MCL (Code of Maryland Regulations [COMAR] 26.08.02. Water Quality, 1991).
[c] Maximum contaminant level goal (USEPA, 1992a).
[d] Secondary MCL (USEPA, 1992a).
[e] Federal MCL (USEPA, 1992a).

MCL Maximum contaminanl level.
Mean Arithmetic average of the total number of sample, using proxy concentrations for non-detects.
NA Not available.
Total range All values used in the mean and UCL calculations, including proxy concentrations for non-detects.
UCL 95 percent upper confidence limit (one-tailed) on tho mean, assuming a normal distribution.

TABLE 8

Occurrence Summary for Constituents Detected in Surface Soil Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	NOAA ER-L	NOAA ER-M	Upgradient Range [a] Min - Max
VOCs								
Acetone	1 / 5	0.031	0.006 - 0.031	0.011	0.022	NA	NA	<0.012 - <0.013
Semi-VOCs								
Benzo(b)fluoranthene	1 / 5	0.064	0.064 - 0.064	0.064	0.064	NA	NA	<0.83 - <0.89
Bis(2-ethylhexyl)phthalate	5 / 5	0.06 - 6.1	0.06 - 6.1	1.3	3.9	NA	NA	<0.83 - 0.16
Di-n-butylphthalate	1 / 5	0.086	0.086 - 0.086	0.086	0.086	NA	NA	<0.83 - 0.1
Fluoranthene	1 / 5	0.054	0.054 - 0.054	0.054	0.054	0.6	3.6	<0.83 - <0.89
Pyrene	1 / 5	0.057	0.057 - 0.057	0.057	0.057	0.35	22	<0.83 - <0.89
Inorganics								
Aluminum	5 / 5	5,200 - 13,400	5,200 - 13,400	8,800	12,000	NA	NA	9,490 - 10,700
Barium	5 / 5	30.5 - 142	30.5 - 142	72	110	NA	NA	38.2 - 63.8
Beryllium	2 / 5	0.49 - 0.53	0.12 - 0.53	0.28	0.4B	NA	NA	0.29 - 0.43
Calcium	5 / 5	365 - 8,490	365 - 8,490	4,000	7,700	NA	NA	1,390 - 1,590
Chromium	5 / 5	12.9 - 207	12.9 - 207	54	140	80	145	19.2 - 20.8
Cobalt	5 / 5	3.5 - 15	3.5 - 15	8.2	13	NA	NA	3.6 - 10.1
Copper	5 / 5	4.9 - 19.5	4.9 - 19.5	11	17	70	390	11.4 - 18.5
Cyanide	5 / 5	0.82 - 1.5	0.82 - 1.5	1.2	1.5	NA	NA	0.73 - 1.9
Iron	5 / 5	10,500 - 47,000	10,500 - 47,000	20,000	35,000	NA	NA	15,500 - 19,700
Lead	4 / 5	11.7 - 17.5	4.35 - 17.5	12	17	35	110	13.1 - 28.6
Magnesium	5 / 5	863 - 2,500	863 - 2,500	1,400	2,000	NA	NA	3,210 - 11,300
Manganese	5 / 5	257 - 831	257 - 831	510	740	NA	NA	95.7 - 468
Mercury	4 / 5	0.13 - 0.25	0.06 - 0.25	0.14	0.21	0.15	1.3	0.14 - 0.14
Nickel	5 / 5	5 - 28.7	5 - 28.7	12	21	30	50	5.1 - 12.7
Potassium	5 / 5	303 - 886	303 - 886	590	820	NA	NA	421 - 1,620
Sodium	5 / 5	63.7 - 746	63.7 - 746	290	540	NA	NA	69.7 - 104
Vanadium	5 / 5	19.2 - 53.7	19.2 - 53.7	30	43	NA	NA	26.4 - 34.2
Zinc	5 / 5	20.1 - 53	20.1 - 53	39	52	120	270	38.6 - 58.6

Footnotes appear on page 2.

TABLE 9

Occurrence Summary for Constituents Detected in Surface Soil Samples, Bush Valley Landfill, Harford County, Maryland.

Concentration are reported in milligrams per kilogram (mg/kg).

Surface soil samples inlcude SUS4, SUS5, SUS6, SUS7, and SUS8 collected within top 6 inches.

[a]	Range of concentrations in upgradient surfial soil samples SUS1, SUS2, and SUS3 collected within top 6 inches.
ER-L	Effects range-low (NOAA, 1990).
ER-M	Effects range median (NOAA, 1990).
Mean	Arithmetic average of the total number of sample, using proxy concentrations for non-detects.
NA	Not available.
NOAA	National Oceanic and Atmospheric Adminstration.
Total range	All values used in the mean and UCL calculations, including proxy concentrations for non-detects.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOCs	Volatile organic compounds.

TABLE 9
(continued)

Occurrence Summary for Constituents Detected in the Northeast and Southeast Sedimentation Basins Surface-Water Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	Surface-Water Criteria [a]	Upgradient Range [b] Min - Max
VOCs							
Carbon Disulfide	2 / 2	0.003 - 0.032	0.003 - 0.032	0.018	0.11	NA	<0.010 - <0.010
Inorganics (total)							
Aluminum	2 / 2	2.2 - 2.35	2.2 - 2 .35	23	2.7	0.087 [c]	<0.116 - 0.153
Barium	2 / 2	0.0425 - 00862	0.0425 - 0.0862	0.064	0.20	NA	0.02 - 0.0245
Calcium	2 / 2	36.8 - 77.9	36.8 - 77.9	57	190	NA	14.9 - 20.9
Chromium	2 / 2	0.0066 - 0.0122	0.0066 - 0.0122	0.0094	0.027	0.21 (0.011)	<0.008 - <0.010
Copper	2 / 2	0.0054 - 0.0055	0.0054 - 0.0055	0.0055	0.0058	0.012	0.0071 - 0.0071
Iron	2 / 2	3.24 - 3.75	3.24 - 3.75	3.5	5.1	1.0 [d]	0.124 - 0.327
Lead	2 / 2	0.0023 - 0.0035	0.0023 - 0.0035	0.0029	0.0067	0.0032	<0001 - <0.002
Magnesium	2 / 2	12.4 - 18.2	12.4 - 18.2	15	34	NA	6.04 - 7.51
Manganese	2 / 2	0.083 - 0.227	0.083 - 0.227	0.16	0.61	NA	0.0253 - 0.0474
Potassium	2 / 2	4.43 - 18.7	4.43 - 18.7	12	57	NA	1.82 - 2.69
Sodium	2 / 2	30.4 - 67.6	30.4 - 67.6	49	170	NA	8.57 - 10.5
Zinc	1 / 2	0.0574 - 0.0574	0.0233 - 0.0574	0.040	0.15	0.11	<0.0092 - <0.0156
Inorganics (dissolved)							
Aluminum	1 / 2	0.0847	0.008 - 0.0847	0.046	0.29	0.087 [c]	<0061 - <0.116
Barium	2 / 2	0.0343 - 0.0797	0.0343 - 0.0797	0.057	0.20	NA	0.0193 - 0.023
Calcium	2 / 2	41.1 - 82.1	41.1 - 82.1	62	190	NA	16.9 - 22.3
Copper	1 / 2	0.0062	0.0025 - 0.0062	0.0044	0.016	0.012	<0.006 - <0.007
Iron	1 / 2	0.114	0.0258 - 0.114	0.07	0.35	1.0 [d]	0.0662 - 0.0904
Magnesium	2 / 2	13.5 - 18.7	13.5 - 18.7	16	33	NA	6.96 - 8.11
Manganese	2 / 2	0.0749 - 0.192	0.0749 - 0.192	0.13	0.50	NA	0.0223 - 0.0419
Potassium	2 / 2	4.74 - 19.4	4.74 - 19.4	12	58	NA	2.05 - 2.75
Sodium	2 / 2	33.3 - 69.9	33.3 - 69.9	52	170	NA	8.94 - 11.2

Footnotes appear on page 2.

TABLE 10

Occurrence Summary for Constituents Detected in the Northeast and Southeast Sedimentation Basins Surface-Water Samples,
Bush Valley Landfill, Harford County, Maryland.

Concentrations are reported in milligrams per liter (mg/L).

Northeast and Southeast Basins surface-water samples include SW8 and SW9, respectively.

[a]	Maryland Chronic Toxic Substances Criteria for the protection of freshwater aquatic life (COMAR, 26.08.02, Water Quality, [1992]), unless specified otherwise.
[b]	Range of concentrations in upgradient surface-water samples SW-1 and SW-5. If the constituent was not detected in the upgradient samples, the dectection limit is reported.
[c]	No Maryland Surface-Water Quality Criteria available. Value presented is the Federal Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic life via chronic exposure (USEPA, 1986).
[d]	No Maryland Surface-Water Quality Criteria available. Value presented in the Federal Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic life via chronic exposure (USEPA, 1992).

Mean	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA	Not available.
UCL	95 percent upper confident limit (one-tailed) on the mean, assuming a ormal distribution.
Total range	All values used in the mean UCL calculations, including proxy concentrations for non-detects.
VOCs	Volatile organic compounds.

TABLE 10
(continued)

Occurrence Summary for Constituents Detected in Northeast and Southeast Sedimentation Basins Sediment Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	NOAA ER-L	NOAA ER-M	Upgradient Range [a] Min - Max
Semi-VOCs								
Bis(2-ethythexyl)phthalate	2 / 2	0.13 - 0.3	0.13 - 0.3	0.22	0.75	NA	NA	<0.40 - <0.42
Inorganics								
Aluminum	2 / 2	7,120 - 12,900	7,120 - 12,900	10,000	28,000	NA	NA	1,980 - 2,370
Barium	2 / 2	29.4 - 68.8	29.4 - 68.8	49	170	NA	NA	18.3 - 19
Calcium	2 / 2	883 - 2,300	883 - 2,300	1,600	6,100	NA	NA	860 - 1,790
Chromium	2 / 2	19.6 - 31.3	19.6 - 31.3	25	62	80	145	10.9 - 13
Cobalt	2 / 2	4.5 - 8.5	4.5 - 8.5	6.5	19	NA	NA	3.8 - 4.5
Copper	2 / 2	9.3 - 14.2	9.3 - 14.2	12	27	70	390	4.8 - 6.5
Cyanide	2 / 2	0.78 - 0.79	0.78 - 0.79	0.79	0.82	NA	NA	<0.60 - <0.62
Iron	2 / 2	13,900 - 23,700	13,900 - 23,700	19,000	50,000	NA	NA	6,740 - 9,540
Lead	1 / 2	12.9	3 - 12.9	8.0	39	35	110	<4.3 - <10.4
Magnesium	2 / 2	1,090 - 1,920	1,090 - 1,920	1,500	4,100	NA	NA	848 - 1,120
Manganaese	2 / 2	196 - 636	196 - 636	420	1,800	NA	NA	127 - 196
Mercury	1 / 2	0.14	0.06 - 0.14	0.10	0.35	0.15	1.3	<0.12 - <0.12
Nickel	2 / 2	6.4 - 10.5	6.4 - 10.5	8.5	21	30	50	5.7 - 8.1
Potasium	2 / 2	527 - 683	527 - 683	610	1,100	NA	NA	184 - 335
Sodium	2 / 2	88.4 - 89.7	88.4 - 89.7	89	93	NA	NA	<57.8 - <110
Vanadium	2 / 2	24.3 - 43	24.3 - 43	34	93	NA	NA	8.8 - 12.3
Zinc	2 / 2	37.3 - 88.2	37.3 - 88.2	63	220	120	270	<22 - 31.4

Footnotes appear on page 2.

Occurrence Summary for Constituents Detected in Northeast and Southeast Sedimentation Basins Sediment Samples, Bush Valley Landfill, Harford Country, Maryland.

Concentrations are reported in milligrams per kilogram (mg/kg).

Northeast and Southeast Sedimentation Basins sediment samples include SD8 and SD9, respectively.

[a]	Range of concentrations in stream upgradient sediment samples SD-1 and SD-5.
ER-L	Effect range-low (NOAA, 1990).
ER-M	Effects range-median (NOAA, 1990)
Mean	Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA	Not available.
NOAA	National Oceanic and Atmospheric Administration.
Total range	All values used in the mean and UCL calculations, including proxy concentrations for non-detects.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 11
(continued)

Occurrence Summary for Constituents Detected in the Drainage Ditch Surface-Water Samples, Bush Valley Landfill, Hardford County, Maryland.

Constituent	Drain Ditch SW2 3/12/93	Surface-Water Criteria [a]	Upgradient Range [b] Min - Max
Inorganic (total)			
Aluminum	0.232	0.087 [c]	<0.116 - 0.153
Barium	0.050	NA	0.02 - 0.0245
Calcium	25.9	NA	14.9 - 20.9
Cobalt	0.0147	NA	<0.007 - <0.014
Copper	0.0052	0.012	0.0071 - 0.0071
Iron	1.43	1.0 [d]	0.124 - 0.327
Lead	0.0082	0.0032	<0.001 - <0.002
Magnesium	8.13	NA	6.04 - 7.51
Manganese	0.960	NA	0.0253 - 0.0474
Nickel	0.0105	0.16	<0.007 - <0.014
Potassium	5.93	NA	1.82 - 2.69
Sodium	24:6	NA	8.57 - 10.5
Zinc	0.0209	0.11	<0.0092 - <0.0156
Inorganics (dissolved)			
Aluminum	0.0376	0.087 [c]	<0.061 - <0.116
Barium	0.0454	NA	0.00193 - 0.023
Calcium	28.4	NA	16.9 - 22.3
Cobalt	0.0098	NA	<0.007 - <0.014
Iron	0.489	1.0 [d]	0.0662 - 0.0904
Magnesium	8.77	NA	6.96 - 8.11
Manganese	1.03	NA	0.0223 - 0.0419
Potassium	6.21	NA	2.05 - 2.75
Sodium	26.4	NA	8.94 - 11.2
Zinc	0.0084	0.11	<0.002 - <0.003

Footnote appear on page 2.

TABLE 12

Occurrence Summary for Constituents Detected in the Drainage Ditch Surface-Water Samples,
Bush Valley Landfill, Harford County, Maryland.

Concentration are reported in milligrams per liter (mg/L).

[a] Maryland Chronic Toxix Substanes Criteria for the protection of freshwater aquatic life (COMAR, 26.08.02, Water Quality, [1992]), unless specified otherwise.

[b] Range of concentrations is upgradient surface-water samples SW-1 and SW-5. If the constituent was not detected in the upgradient samples, the detection limit is reported.

[c] No Maryland Surface-Water Quality Criteria available. Value presented is the Federal Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic life via chronic exposure (USEPA, 1986).

[d] No Maryland Surface-Water Quality Criteria available. Value presented is the Federal Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic life via chronic exposure (USEPA, 1992).

NA Not available.

TABLE 12
(continued)

Occurrence Summary for Constituents Detected in Drainage Ditch Sediment Samples, Bush Valley Landfill, Harfold County, Maryland.

Contituent	Drainage Ditch SD2 08/12/92	NOAA ER-L	NOAA ER-M
Inorganics			
Aluminum	17800	NA	NA
Arsenic	3.7	33	85
Barium	131	NA	NA
Beryllium	0.65	NA	NA
Calcium	2870	NA	NA
Chromium	30.7	80	145
Cobalt	18.8	NA	NA
Copper	25	70	390
Iron	31400	NA	NA
Lead	26.1	35	110
Magnesium	4030	NA	NA
Manganaese	1970	NA	NA
Potasium	1340	NA	NA
Vanadium	46	NA	NA

Concentrations are reported in milligrams per kilogram (mg/kg).

ER-L Effects range-low (NOAA, 1990).
ER-M Effecls range-median (NOAA. 1990).
NA Not available.
NOAA National Oceanic and Atmospheric Administration.

TABLE 13

Occurrence Summary for Constituents Detected in the Bynum Run Creek Surface-Water Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	Surface-Water Criteria [a]	Upgradient Range [b] Min - Max
Inorganic (Total)							
Aluminum	2 / 4	00756 - 0.0889	0.058 - 0.0889	0.07	0.088	0.087 [c]	<0.116 - 0.153
Barium	4 / 4	0.0189 - 0.0215	0.0189 - 0.0215	0.02	0.021	NA	0.02 - 0.0245
Calcium	4 / 4	15.6 - 16.7	15.6 - 16.7	16	17	NA	14.9 - 20.9
Iron	4 / 4	0.254 - 0.32	0.254 - 0.32	0.28	0.3	1.0 [d]	<0.124 - 0.327
Magnesium	4 / 4	6.27 - 6.72	6.27 - 6.72	6.5	6.8	NA	6.04 - 7.51
Manganese	4 / 4	0.0373 - 0.048	0.0373 - 0.048	0.044	0.05	NA	0.0253 - 0.0474
Potassium	4 / 4	2.03 - 2.27	2.03 - 2.27	2.2	2.3	NA	1.82 - 2.69
Selenium	1 / 4	0.001	0.0005 - 0.001	0.00063	0.00092	0.005	<0.001 - <0.001
Sodium	4 / 4	8.61 - 10	8.61 - 10	9.3	10	NA	8.57 - 10.5
Zinc	3 / 4	0.0052 - 0.0265	0.0052 - 0.0265	0.011	0.023	0.11	<0.0092 - <0.0156
Inorganics (dissolved)							
Barium	4 / 4	0.0188 - 0.0202	0.0188 - 0.0202	0.02	0.02	NA	0.0193 - 0.023
Calcium	4 / 4	16.8 - 17.5	16.8 - 17.5	17	17	NA	16.9 - 22.3
Iron	4 / 4	0.0965 - 0.156	00965 - 0.156	0.13	0.16	1.0 [d]	0.0662 - 0.0904
Magnesium	4 / 4	6.81 - 7.1	6.81 - 7.1	6.9	7.1	NA	6.96 - 8.11
Manganese	4 / 4	0.0341 - 0.0449	0.0341 - 0.0449	0.041	0.047	NA	0.0223 - 0.0419
Mercury	1 / 4	0.0003	0.0001 - 0.0003	0.00016	0.00030	0.000012	<0.0002 - <0.0002
Potassium	4 / 4	2.14 - 2.41	2.14 - 2.41	2.3	2.4	NA	2.05 - 2.75
Sodium	4 / 4	9.06 - 10.4	9.06 - 10.4	9.7	1 1	NA	8.94 - 11.2

Concentrations are reported in milligrams per liter (mg/L).

Bynum Run Creek surface-water samples include SW3 and SW4.

[a] Maryland Chronic Toxic Substances Citeria for the protection of fleshwater aquatic life (COMAR. 26.08.02, Water Quality, [1992]), unless specified otherwise.
[b] Range of concentrations in upgradient surface-water samples SW-1 amd SW-5. If the constituent was not detected in the upgradient samples, the detection limit is reported.
[c] No Maryland Surface-Water Quality Criteria available. Value presented is the Federal Ambient Water Quality Criteria (AWQC) for the protected of freshwater aquatic life via chronic exposure (USEPA, 1986).
[d] No Maryland Surface-Water Qualily Criteria available. Value presented is the Federal Ambient Water Quality Crieria (AWQC) for the protection of freshwater aquatic life via chronic exposure (USEPA, 1992)

Mean Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA Not Available.
Total range All values used in the mean UCL calculations, including proxy concentrations for non-detects.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 14

Occurence Summary for Constituents Detected in the Bynum Run Creek Surface-Water Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	NOAA ER-L	NOAA ER-M	Upgradient Range [b] Min - Max
Inorganics								
Aluminum	2 / 2	1,740 - 1,850	1,740 - 1,850	2,800	2,100	NA	NA	1,980 - 2,370
Arsenic	1 / 2	1	0.37 - 1	0.68	2.7	33	85	<0.75 - 1.8
Chromium	2 / 2	6.2 - 8.5	6.2 - 8.5	7.4	15	180	145	10.9 - 13
Copper	2 / 2	3.3 - 5.1	3.3 - 5.1	4.2	9.9	70	390	4.8 - 6.5
Iron	2 / 2	6,570 - 7,300	6,570 - 7,300	6,900	9,200	NA	NA	6,740 - 9,540
Magnesium	2 / 2	706 - 1,060	706 - 1,060	880	2,000	NA	NA	848 - 1,120
Manganaese	2 / 2	62.1 - 78.3	62.1 - 78.3	70	120	NA	NA	127 - 190
Potasium	2 / 2	206 - 266	206 - 268	240	430	NA	NA	184 - 335
Vanadium	2 / 2	8.8 - 9.1	8.8 - 9.1	9.0	9.9	NA	NA	8.8 - 12.3

Concentrations are reported in milligrams per kilogram (mg/kg).

Bynum Run Creek sediement samples include SD3 and SD4.

[a] Range of concentrations in stream upgradient sediment samples SD-1 and SD-5.

EK-L Effects range-low (NOAA, 1990).
EL-M Effect range-median (NOAA, 1990).
Mean Arithmetic average of the told number of samples, using proxy concentrations for non-detects.
NA Not available.
NOAA National Oceanic Antimospheric Administration.
Total range All values used in the mean and UCL calculations, including proxy concentrations for non-detects.
UCL 95 percent upper confidence limit (one tailed) on the mean, assuming a normal distribution.

TABLE 15

Occurrence Summary for Constituents Detected in Bush River Tributary Surface-Water Samples, Buksh Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	Surface-Water Criteria [a]	Upgradient Range [b] Min - Max
Inorganic (total)							
Barium	2 / 2	0.021 - 0.0216	0.0209 - 0.0216	0.021	0.023	NA	0.02 - 0.0245
Calcium	2 / 2	16.9 - 19.1	16.9 - 19.1	18	25	NA	14.9 - 20.9
Iron	2 / 2	0.423 - 0.432	0.423 - 0.432	0.43	0.46	10 [c]	0.124 - 0.32/
Magnesium	2 / 2	6.57 - 7.47	6.57 - 7.47	7.0	9.9	NA	6.04 - 7.51
Manganese	2 / 2	0.08 - 0.0811	0.08 - 0.0811	0.081	0.084	NA	0.0253 - 0.0474
Potasium	2 / 2	1.93 - 2.62	1.93 - 2.62	2.3	4.5	NA	1.82 - 2.69
Sodium	2 / 2	9.82 - 9.88	9.82 - 9.88	9.9	10	NA	8.57 - 10.5
Inorganics (dissolved)							
Barium	2 / 2	0.02 - 0.0222	0.0204 - 0.0222	0.027	0.021	NA	0.0193 - 0.0023
Calcium	2 / 2	17.9 - 20.8	17.9 - 20.8	19	29	NA	16.9 - 22.3
Iron	2 / 2	0.169 - 0.342	0.169 - 0.342	0.26	0.8	1.0 [c]	0.0662 - 0.0904
Magnesium	2 / 2	7.12 - 8.21	7.12 - 8.21	7.7	11	NA	6.96 - 8.11
Manganese	2 / 2	0.075 - 0.0821	0.0749 - 0.0821	0.079	0.10	NA	0.0223 - 0.0419
Potassium	2 / 2	2.12 - 2.66	2.12 - 2.66	2.4	4.1	NA	2.05 - 2.75
Sodium	2 / 2	10.3 - 10.5	10.3 - 10.5	10	11	NA	8.94 - 11.2

Concentrations are reported in milligrams per liter (mg/L).

Bush River Tributary surface-water samples include SW6.

[a] Maryland Chronic Toxic Substances Criteria for the protection of freshwater aquatic life (COMAR, 26.08.02, Water Quality, [1992]), unless specified otherwise.
[b] Range of concentrations in upgradient surface-water SW-1 and SW-5.
[c] No Maryland Surface-Water Quality Criteria available. Value presented is the Federal Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic life via chronic exposure (USEPA, 1992).

Mean Arithmetic average of the told number of samples, using proxy concentrations for non-detects.
NA Not available.
Total range All values used in the mean and UCL calculations, including proxy concentrations for non-detects.
UCL 95 percent upper confidence limit (one tailed) on the mean, assuming a normal distribution.

TABLE 16

Bush River Tributary and Unnamed Tributary Sediment Samples, Bush Samples, Bush Valley Landfill, Hartford County, Maryland.

Constituent	Bush River Tributary (SD6)	Unnamed Tributary (SD7)	NOAA ER-L	NOAA ER-M	Upgradient Surface-Water Min - Max
Inorganics					
Aluminum	2,950	22,500	NA	NA	1,980 - 2.370
Arsenic	<0.73	3.1	33	85	<0.75 - 1.8
Barium	28.4	136	NA	NA	18.3 - 19
Beryllium	<0.24	0.78	NA	NA	<0.24 - 0.38
Calcium	3140	<1640	NA	NA	860 - 1,790
Chromium	9.1	38.8	80	145	10.9 - 13
Cobalt	4.6	20.5	NA	NA	3.8 - 4.5
Copper	3.4	31.1	70	390	4.8 - 6.5
Cyanide	2.8	<1.2	NA	NA	<0.60 - <0.62
Iron	6,550	48,900	NA	NA	6,740 - 9,540
Lead	<4.0	39.7	35	110	<4.3 - <10.4
Magnesium	999	4,320	NA	NA	848 - 1,120
Manganaese	602	1,980	NA	NA	127 - 196
Nickel	5.7	<27.2	30	50	5.7 - 8.1
Potasium	580	997	NA	NA	184 - 335
Sodium	<94.8	<175	NA	NA	<5.78 - <110
Vanadium	10.6	64.5	NA	NA	8.8 - 12.3
Zinc	30.8	<92.8	120	270	<22 - 31.4

Concentration are reported in milligrams per kilogram (mg/kg).

[a] Range of concentration is stream upgradient sediment samples SD-1 and SD-5.

ER-L Effects range-low (NOAA, 1990).
ER-M Effects range-median (NOAA, 1990).
NA Not available.
NOAA National Oceanic and Atmospheric Administration.

TABLE 17

Occurrence Summary for Constituents Detected in the Unnamed Tributary Surface-Water Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	Surface-Water Criteria [a]	Upgradient Range [b] Min - Max
Inorganic (total)							
Aluminum	2 / 2	0.126 - 0.337	0.126 - 0.337	0.23	0.90	0.087 [c]	<0.116 - 0.153
Barium	2 / 2	0.03 - 0.0483	0.03 - 0.0483	0.039	0.097	NA	0.02 - 0.0245
Calcium	2 / 2	20.2 - 20.2	20.2 - 20.2	20	20	NA	14.9 - 20.9
Iron	2 / 2	3.96 - 14.7	3.96 - 14.7	9.3	43	1.0 [d]	0.124 - 0.327
Magnesium	2 / 2	9.8 - 11.3	9.8 - 11.3	11	15	NA	6.04 - 7.51
Manganese	2 / 2	3.77 - 4.22	3.77 - 4.22	4.0	5.4	NA	0.0253 - 0.0474
Potassium	2 / 2	0.978 - 1.76	0.918 - 1.76	1.4	3.8	NA	1.82 - 2.69
Sodium	2 / 2	23.3 - 33.6	23.3 - 33.6	28	61	NA	8.57 - 10.5
Zinc	2 / 2	0.0036 - 0.102	0.0036 - 0.102	0.053	0.36	0.11	<0.0092 - <0.0156
Inorganics (dissolved)							
Barium	2 / 2	0.0309 - 0.0443	0.0309 - 0.0443	0.038	0.08	NA	0.0193 - 0.023
Calcium	2 / 2	22.4 - 22.7	22.4 - 22.7	23	23	NA	16.9 - 22.3
Iron	2 / 2	3.02 - 8.14	3.02 - 8.14	5.6	22	1.0 [d]	0.0622 - 0.0904
Magnesium	2 / 2	11.1 - 12.6	11.1 - 12.6	12	17	NA	6.96 - 8.11
Manganese	2 / 2	4.1 - 4.63	4.1 - 4.63	4.4	6.0	NA	0.0223 - 0.0419
Potassium	2 / 2	1.01 - 1.91	1.01 - 1.91	1.5	4.3	NA	2.05 - 2.75
Sodium	2 / 2	26.2 - 36.5	26.2 - 36.5	31	64	NA	8.94 - 11.2

Concentrations are reported in milligams per liter (mg/L).

Unnamed Tributary surface-water samples include SW7.

[a] Maryland Chronic Toxic Substances Citeria for the protection of freshwater aquatic life (COMAR. 26.08.02, Water Quality, [1992]), unless specified otherwise.
[b] Range of concentrations in upgradient surface-water samples SW-1 amd SW-5.
[c] No Maryland Surface-Water Quality Criteria available. Value presented is the Federal Ambient Water Quality Criteria (AWQC) for the protection of freshwater aquatic life via chronic exposure (USEPA, 1986).
[d] No Maryland Surface-Water Qualily Criteria available. Value presented is the Federal Ambient Water Quality Crieria (AWQC) for the protection of freshwater aquatic life via chronic exposure (USEPA, 1992)

Mean Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
Total range All values used in the mean UCL calculations, including proxy concentrations for non-detects.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.

TABLE 18

Occurrence Summary for Constituents Detected in Marsh Sediment Samples, Bush Valley Landfill, Hartford County, Maryland,

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	NOAA ER-L	NOAA ER-M
VOCs							
1,2-Dichloropropane	1 / 9	0.004	0.004 - 0.004	0.0040	0.0040	NA	NA
Semi-VOCs							
Benzo(b)fluoranthene	5 / 9	0.058 - 0.31	0.058 - 0.31	0.19	0.25	NA	NA
Bis(2-ethythexyl)phthalate	5 / 9	0.058 - 0.21	0.058 - 0.21	0.16	0.20	NA	NA
Butybenzylphthalate	2 / 9	0.14 - 0.65	0.14 - 0.65	0.44	0.57	NA	NA
Di-n-butylphthalate	4 / 9	0.11 - 0.72	0.11 - 0.72	0.39	0.53	NA	NA
Fluoranthene	3 / 9	0.052 - 0.15	0.052 - 0.15	0.14	0.16	0.6	3.6
Pyrene	2 / 9	0.099 - 0.12	0.099 - 0.12	0.12	0.12	0.35	2.2
Inorganics							
Aluminum	8 / 9	7,330 - 24,800	7,330 - 24,800	16,000	20,000	NA	NA
Arsenic	8 / 9	1.4 - 3.1	1.4 - 3.1	2.3	2.6	33	85
Barium	9 / 9	31.5 - 119	31.5 - 119	84	100	NA	NA
Beryllium	8 / 9	0.26 - 0.96	0.175 - 0.96	0.54	0.70	NA	NA
Calcium	1 / 9	1,470	301 - 1,470	1,100	1,300	NA	NA
Chromium	9 / 9	17.4 - 46.3	17.4 - 46.3	34	41	80	145
Cobalt	9 / 9	6.6 - 23	6.6 - 23	14	18	NA	NA
Copper	9 / 9	9 - 34	9 - 34	24	29	70	390
Cyanide	4 / 9	1.2 - 1.9	0.28 - 1.9	0.84	1.2	NA	NA
Iron	9 / 9	11,600 - 37,300	11,600 - 37,300	27,000	32,000	NA	NA
Lead	6 / 9	15.3 - 37.6	4.5 - 37.6	18	24	35	110
Magnesium	9 / 9	1,420 - 5,090	1,420 - 5,090	3,700	4,600	NA	NA
Manganaese	9 / 9	219 - 961	219 - 961	560	720	NA	NA
Mercury	1 / 9	0.19	0.045 - 0.19	0.084	0.11	0.15	1.3
Nickel	1 / 9	17.5	4.2 - 17.5	11	14	30	50
Potsssium	9 / 9	430 - 1,550	430 - 1,550	1,100	1,300	NA	NA
Sodium	1 / 9	129	23.1 - 129	79	100	NA	NA
Vanadium	9 / 9	21 - 69.1	21 - 69.1	50	60	NA	NA
Zinc	9 / 9	41.1 - 118	41.1 - 118	88	100	120	270

Footnotes appear on page 2.

TABLE 19

Occurrence Summary for Constituents Detected in March Sediment Samples, Bush Valley Landfill, Harford County, Maryland

Concentrations are reported in milligrams per kilograms (mg/kg)

March sediment samples inlcude MSD1 through MSD9.

ER-L	Effects range-low (NOAA, 1990).
ER-M	Effects range-median (NOAA, 1990)
Mean	Arithmeric avarage of the total number of sampls, using proxy concentrations for non-detects.
NA	Not available.
NOAA	National Oceanic and Atmospheric Administration.
Total range	All values used in the mean and UCL calculations, uncluding proxy concentrations for non-detects.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOCs	Volatile organic compounds.

TABLE 19
(continued)

Occurrence Summary for Volatile Organic Constituents Detected in Upwind Ambient Air Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	MEG
VOCs						
Acetone	3 / 3	0.521 - 1.943	0.521 - 1.943	1.3	2.5	1,405
Benzene	3 / 3	1.108 - 2.589	1.108 - 2.589	1.7	3.0	71.4
Carbon disulfide	2 / 3	1.043 - 2.342	0.0055 - 2.342	1.1	3.1	143
Chloroform	3 / 3	0.087 - 0.124	0.087 - 0.124	0.11	0.15	23
Chloromethane	2 / 3	0.464 - 0.767	0.0095 - 0.767	0.41	1.1	500
Ethylbenzene	2 / 3	0.384 - 0.58	0.005 - 0.58	0.32	0.82	1,040
Melbylene chloride	3 / 3	72.26 - 106:043	72.26 - 106	86	120	619
Tetrachloroethene	3 / 3	0.152 - 0.739	0.152 - 0.739	0.37	0.91	1,595
Toluene	3 / 3	3.014 - 23.032	3.014 - 23.03	10	29	843
1,1,1-Trichloroethane	3 / 3	1.247 - 3.038	1.247 - 3.038	1.9	3.6	1,274
Trichloroethene	3 / 3	20.822 - 89.623	20.822 - 89.62	52	110	1,274
Trichlorofluoromethane	2 / 3	0.406 - 0.863	0.0095 - 0.863	0.43	1.1	NA
Xylenes (total)	3 / 3	1.096 - 1.681	1.096 - 1.681	1.5	2	1,040

Concentrations are repeated in micrograms per cubic meter (:g/m3).

Mean	Arithmeric average of the total number of samples, using proxy cocentrations for non-detects.
MBG	Multimedia Environmental Goal.
NA	Not available.
Total range	All values used in the mean and UCL calculations, including proxy concentrations for non-detects.
UCL	95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOCs	Volatile origanic compounds.

TABLE 20

Occurrence Summary for Volatile Organic Constituents Detected in Downwind Ambient Air Samples, Bush Valley Landfill, Harford County, Maryland.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Total Range Min - Max	Mean	UCL	MEG
VOCs						
Acetone	4 / 5	0.725 - 3.955	0.0395 - 3.955	1.3	28	1,405
Benzene	5 / 5	1.347 - 1.708	1.347 - 1.708	1.5	16	71.4
Carbon disulfide	4 / 5	0.011 - 1.5	0.0055 - 1.5	0.52	1.1	143
Carbon tetrachloride	2 / 5	0.521 - 3.594	0.0005 - 3.594	0.92	2.4	30
Ethylbenzene	4 / 5	0.011 - 1.5	0.005 - 1.5	0.44	1	1,040
Methylene chloride	5 / 5	9.072 - 240	9.072 - 240	100	210	619
Tetrachlorothene	5 / 5	0.011 - 0.764	0.011 - 0.764	0.34	0.63	1,595
Toluene	5 / 5	1.98 - 33.169	1.98 - 33.17	9.6	22	843
1,1,1-Trichloroethane	5 / 5	1.014 - 27.38	1.014 - 27.38	6.8	18	1,274
Trichloroethene	5 / 5	2.101 - 88.15	2.101 - 88.16	31	64	1,274
Triochlorofluomethane	3 / 5	0.795 - 1.792	0.011 - 1.792	0.69	1.4	NA
Xylenes (total)	4 / 5	0.033 - 7.097	0.0055 - 7.097	2.1	4.9	1,040

Concentrations are reported in micrograms per cubic meter (:m/m3).

[a] An MEG is not available for cis-1-2-dichloroethene; MEG for trans-1-2-dichlroethene is 95 :g/m3.

Mean Arithmeric average of the total number of samples, using proxy cocentrations for non-detects.
MEG Multimedia Environmental Goal.
Total range All values used in the mean and UCL calculations, including proxy concentrations for non-detects.
UCL 95 percent upper confidence limit (one-tailed) on the mean, assuming a normal distribution.
VOCs Volatile origanic compounds.

TABLE 21

TABLE 22

SUMMARY OF REPRESENTATIVE CONCENTRATIONS OF CHEMICALS OF CONCERN BUSH VALLEY LANDFILL

	MILTON (UG/L)	FLEET WASHING-TON (UG/L)	(UG/L)	SPLIT STREAM SED (MG/KG)	MARSH SED 1 (MG/KG)	MARSH SED 2 (MG/KG)
MANGANESE	232	22.2	111	N/A	N/A	NA
BERYLLIUM	N/A	N/A	N/A	0.34.	0.74	0.96
ARSENIC	N/A	N/A	N/A	N/A	2.6	3.1
CHROMIUM	N/A	N/A	N/A	N/A	42.5	45.7
VANADIUM	N/A	N/A	N/A	N/A	63.4	67.6
ALUMINUM	N/A	N/A	N/A	N/A	N/A	24800
VINYL CHLORIDE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	N/A
BENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
CHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	N/A	N/A
CADMIUM	N/A	N/A	N/A	N/A	N/A	N/A
ALPHA-HCH	N/A	N/A	N/A	N/A	N/A	N/A
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
LEAD	N/A	5.2	N/A	N/A	N/A	N/A

	SPLIT MARSH SED 2 (MG/KG)	SURF SOIL (MG/KG)	SPLIT SURF SOIL (MG/KG)	SURF DUST (MG/KG)	SW-7 (UG/L)	SD-2 (MG/KG)
MANGANESE	N/A	N/A	N/A	737	4220	1970
BERYLLIUM	0.96	0.53	0.53	N/A	N/A	0.65
ARSENIC	5.2	N/A	3.5	N/A	N/A	3.7
CHROMIUM	45.7	207	207	207	N/A	N/A
VANADIUM	67.6	52.94	52.94	N/A	N/A	N/A
ALUMINUM	24800	N/A	N/A	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	N/A
BENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
CHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	N/A	N/A
CADMIUM	N/A	N/A	N/A	N/A	N/A	N/A
ALPHA-HCH	N/A	N/A	N/A	N/A	N/A	N/A
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
LEAD	N/A	N/A	N/A	N/A	N/A	N/A

TABLE 22 (CONT'D)

SUMMARY OF REPRESENTATIVE CONCENTRATIONS OF CHEMICALS OF CONCERN BUSH VALLEY LANDFILL

	SPLIT SD-7 (MG/KG)	SPLIT SD-9 (MG/KG)	LEACH (UG/L)	MW AREA 1 (UG/L)	SPLIT MW AREA 1 (UG/L)	MW AREA 2 (UG/L)
MANGANESE	1980	N/A	10700	2588	2588	7450
BERYLLIUM	0.78	0.45	N/A	1.125	1.125	2.726
ARSENIC	3.1	6.8	N/A	3.51	5	N/A
CHROMIUM	38.8	N/A	N/A	16.16	16.16	N/A
VANADIUM	64.5	54.7	N/A	N/A	N/A	N/A
ALUMINUM	22500	N/A	N/A	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A	10.03	10.03	3
1,2-DICHLOROETHENE	N/A	N/A	N/A	5.9	5.9	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	75.51	75.51	12.61
1.2-DICHLOROPROPANE	N/A	N/A	N/A	9.53	9.53	N/A
BENZENE	N/A	N/A	N/A	5.32	5.32	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	51.22	51.22	N/A
CHLOROBENZENE	N/A	N/A	N/A	6.77	6.77	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	6.39	6.39	N/A
TRICHLOROETHENE	N/A	N/A	N/A	52	52	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	0.005	N/A
CADMIUM	N/A	N/A	N/A	N/A	5.8	N/A
ALPHA-HCH	N/A	N/A	N/A	N/A	N/A	0.012
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
LEAD	N/A	N/A	215	N/A	N/A	N/A

	SB-5 (MG/KG)	SB-8 (MG/KG)	WELL GM1US (UG/L)
MANGANESE	N/A	N/A	4270
BERYLLIUM	1	0.81	1.2
ARSENIC	N/A	N/A	N/A
CHROMIUM	N/A	N/A	N/A
VANADIUM	N/A	N/A	N/A
ALUMINUM	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A
1,2-DICHLOPROPANE	N/A	N/A	N/A
BENZENE	N/A	N/A	3
TETRACHLOROETHENE	N/A	N/A	34
CHLOROBENZENE	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	11
HEPTACHLOR EPOXIDE	N/A	N/A	N/A
CADMIUM	3.1	8.6	N/A
ALP NA-HCH	N/A	N/A	N/A
AROCLOR 1254.	0.024	0.25	N/A
NICKEL	N/A	N/A	789
LEAD	N/A	N/A	N/A

Table 23 - Reasonable Maximum Exposure Assessment Factors

Children and Adult Residents (Curent and Future)

Exposure Factors	Child (1 to 6 years)	Adult (greater than 7 years)
INGESTION EXPOSURE PATHWAY		
Ingestion Rate:		
Soil and Sediment	200 mg/day	100 mg/day
Surface Water (wading)	0.065 liters/day	0.065 liters/day
Ground Water	1.0 liters/day	2.0 liters/day
Leachate	0.001 liters/exposure	0.001 liters/exposure
Exposure Frequency:		
Soil and Sediment	350 days/year	350 days/year
Covered Sediment	7 days/year	7 days/year
Surface Water (wading)	7 days/year	7 days/year
Ground Water	350 days/year	350 days/year
Leachate	120 days/year	120 days/year
DERMAL CONTACT EXPOSURE PATHWAY		
Surface Area Exposed:		
Soil and Sediment	1,800 cm2	3,000 cm2
Covered Sediment 880 cm2	1,800 cm2	1,800 cm2
Surface Water (wading)	2,700 cm2	3,800 cm2
Ground Water	7,200 cm2	18,000 cm2
Leachate	1,800 cm2	3,000 cm2
Soil/Sediment to Skin Adherence Factor	1.0 mg/cm2	1.0 mg/cm2
Exposure Time per Event:		
Surface Water	2.6 hours	2.6 hours
Groud Water (shower or bath)	0.33 hours	0.2 hours
Exposure Frequency:		
Soil and sediment	350 days/year	350 days/year
Covered Sediment	7 days/year	7 days/year
Surface Water (wading)	7 days/year	7 days/year
Ground Water (shower)	350 days/year	350 days/year
Leachate	120 days/year	120 days/year
INNALATION EXPOSURE PATHWAY		
Inhalation Rate:		
Water Vapor (shower)	N/A	20 m3/day
Exposure Time:		
Water Vapor (shower)	N/A	0.2 hours/day
Exposure Frequency:		
Water Vapor (shower)	N/A	350 days/year

Table 23 - Reasonable Maximum Exposure Assessment Factors

Exposure Factors		Children and Adult Residents (Curent and Future) Child (1 to 6 years)	Adult (greater than 7 years)
EXPOSURE ASSESSMENT CONSTANTS			
Exposure Duration		6 years	24 years
Body Weight		15 kg	70 kg
Averaging Time:			
	Carcinogens	70 years x 365 days/year	70 years x 365 days/year
	Noncarcinogens	6 years x 365 days/year	24 years x 365 days/year

Table 24 - Slope Factors and Reference Doses

Chemical	Slope Factors (mg/kg-day)-1 Oral	Slope Factors (mg/kg-day)-1 Inhalation	Slope Factors (mg/kg-day)-1 Class	Reference Dose (mg/kg-day) Oral	Reference Dose (mg/kg-day) Inhalation
Aluminum				2.9	
Aroclor 1254	7.7		B2		
Arsenic	1.75		A	0.0003	
Benzene	0.029	0.029	A		0.0017
Beryllium	4.3	8.4	B2	0.005	
Cadmium		6.3	B1	0.0005 (W)	
Chlorobenzene				0.02	0.0057
Chromium		41	A	0.005	0.000000571
1,4-Dichlorobenzene	0.024		C		0.23
1,2-Dichloroethane	0.091	0.091	B2		0.0029
1,2-Dichloroethene				0.009	
1,2-Dichloropropane	0.068		B2		0.0011
Alpha-Hexachlorocyclohexane	6.3	6.3			
Manganese				0.005 (W) 0.14 (F)	0.000014
Tetrachloroethene	0.052	0.002	B2	0.01	
Trichloroethene	0.011	0.006		0.006	
Vanadium				0.007	
Vinyl chloride	1.9	0.03	A		
Heptachlor Epoxide	9.1	9.1	B2	0.000013	
Nickel				0.02	

Key: W=Water
F=Food
Class = EPA Weight-Of-Evidence Class for Carcinogenicity

A Human Carcinogen - sufficient evidence from epidemiological studies to support a causal association between exposure and cancer
B Probable Human Carcinogen -
B1 ! At least limited evidence of carcinogenicity to humans from epidemiological studies
B2 ! Usually a combination of sufficient evidence of carcinogenicity in animals and inadequate evidence of carcinogenicity in humans
C Possible Human Carcinogen - limited evidence of caxcinogenicity in animals in the absence of human data
D Not Classified - inadequate evidence of carcinogenicity in animals

TABLE 25

SUMMARY OF QUANTITATIVE CANCER RISKS BUSH VALLEY LANDFILL

	MILTON	FLEET	WASHING-TON	SPLIT STREAM SED	MARSH SED 1	MARSH SED 2
MANGANESE	0.00E+00	0.00E+00	0.00E+00	N/A	N/A	N/A
BERYLLIUM	N/A	N/A	N/A	4.60E-08	5.00E-06	6.40E-06
ARSENIC	N/A	N/A	N/A	N/A	7.10E-06	8.40E-06
CHROMIUM	N/A	N/A	N/A	N/A	0.00E+00	0.00E+00
VANADIUM	N/A	N/A	N/A	N/A	0.00E+00	0.00E+00
ALUMINUM	N/A	N/A	N/A	N/A	N/A	0.00E+00
VINYL CHLORIDE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	N/A
BENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
CHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	N/A	N/A
CADMIUM	N/A	N/A	N/A	N/A	N/A	N/A
ALPNA-HCH	N/A	N/A	N/A	N/A	N/A	N/A
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	0.00E+00	0.00E+00	0.00E+00	4.60E-08	1.21E-05	1.48E-05

	SPLIT MARSH SED 2	SURF SOIL	SPLIT SURF SOIL	SURF DUST	SW-7	SD-2
MANGANESE	N/A	N/A	N/A	0.00E+00	0.00E+00	0.00E+00
BERYLLIUM	6.40E-06	3.60E-06	3.60E-06	N/A	N/A	4.40E-06
ARSENIC	1.43E-05	N/A	9.60E-06	N/A	N/A	1.01E-05
CHROMIUM	0.00E+00	0.00E+00	0.00E+00	1.31E-06	N/A	N/A
VANADIUM	0.006+00	0.00E+00	0.00E+00	N/A	N/A	N/A
ALUMINUM	0.00E+00	N/A	N/A	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	N/A
BENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
CHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	N/A	N/A
CADMIUM	N/A	N/A	N/A	N/A	N/A	N/A
ALPHA-HCH	N/A	N/A	N/A	N/A	N/A	N/A
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	2.07E-05	3.60E-06	1.32E-05	1.31E-06	0.00E+00	1.45E-05

TABLE 25
(continued)

SUMMARY OF QUANTITATIVE CANCER RISKS BUSH VALLEY LANDFILL

	SD-7	SPLIT SD-9	LEACH	MW AREA 1	SPLIT MW AREA 1	MW AREA 2
MANGANESE	0.00E+00	N/A	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BERYLLIUM	1.06E-07	3.01E-06	N/A	8.65E-05	8.65E-05	2.09E-04
ARSENIC	1.71E-07	1.86E-05	N/A	9.22E-05	1.30E-04	N/A
CHROMIUM	0.00E+00	N/A	N/A	0.00E+00	0.00E+00	N/A
VANADIUM	0.00E+00	0.00E+00	N/A	N/A	N/A	N/A
ALUMINUM	0.00E+00	N/A	N/A	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A	3.39E-04	3.39E-04	1.03E-04
1,2-DICHLOROETHENE	N/A	N/A	N/A	0.00E+00	0.00E+00	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	1.91E-04	1.91E-04	3.18E-05
1,2-DICHLOROPROPANE	N/A	N/A	N/A	1.02E-05	1.02E-05	N/A
BENZENE	N/A	N/A	N/A	5.66E-06	5.66E-06	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	1.62E-04	1.62E-04	N/A
CHLOROBENZENE	N/A	N/A	N/A	0.00E+00	0.00E+00	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	3.25E-06	3.25E-06	N/A
TRICHLOROETHENE	N/A	N/A	N/A	2.48E-05	2.48E-05	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	9.76E-07	N/A
CADMIUM	N/A	N/A	N/A	N/A	0.00E+00	N/A
ALPHA-HCH	N/A	N/A	N/A	N/A	N/A	1.94E-06
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	2.77E-07	2.16E-05	0.00E+00	9.15E-04	9.54E-04	3.46E-04

	SB-5	SB-8	WELL GM1US
MANGANESE	N/A	N/A	0.00E+00
BERYLLIUM	6.70E-06	5.40E-06	9.14E-05
ARSENIC	N/A	N/A	N/A
CHROMIUM	N/A	N/A	N/A
VANADIUM	N/A	N/A	N/A
ALUMINUM	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A
1,2-DICHLOROPROPANE	N/A	N/A	N/A
BENZENE	N/A	N/A	3.28E-06
TETRACHLOROETHENE	N/A	N/A	1.15E-04
CHLOROBENZENE	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	5.22E-06
HEPTACHLOR EPOXIDE	N/A	N/A	N/A
CADMIUM	0.00E+00	0.00E+00	N/A
ALPHA-HCH	N/A	N/A	N/A
AROCLOR 1254	5.87E-07	6.10E-06	N/A
NICKEL	N/A	N/A	0.00E+00
TOTAL	7.29E-06	1.15E-05	2.15E-04

TABLE 26

SUMMARY OF QUANTITATIVE CANCER RISKS BUSH VALLEY LANDFILL

	MILTON	FLEET WASHING-TON		SPLIT STREAM SED	MARSH SED 1	MARSH SED 2
MANGANESE	0.13	0.12	0.51	N/A	N/A	N/A
BERYLLIUM	N/A	N/A	N/A	0.000.9	0.000.2	0.00025
ARSENIC	N/A	N/A	N/A	N/A	0.012	0.014
CHROMIUM	N/A	N/A	N/A	N/A	0.012	0.013
VANADIUM	N/A	N/A	N/A	N/A	0.012	0.013
ALUMINUM	N/A	N/A	N/A	N/A	N/A	0.012
VINYL CHLORIDE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	N/A
BENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
CHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	N/A	N/A
CADMIUM	N/A	N/A	N/A	N/A	N/A	N/A
ALPNA-HCH	N/A	N/A	N/A	N/A	N/A	N/A
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	0.013	0.012	0.61	0.00019	0.0362	0.06229
CHILD						
MANGANESE	0.3	0.28	1.4	N/A	N/A	N/A
BERYLLIUM	N/A	N/A	N/A	0.000.7	0.000.9	0.00025
ARSENIC	N/A	N/A	N/A	N/A	0.011	0.013
CHROMIUM	N/A	N/A	N/A	N/A	0.011	0.012
VANADIUM	N/A	N/A	N/A	N/A	0.012	0.012
ALUMINUM	N/A	N/A	N/A	N/A	N/A	0.011
VINYL CHLORIDE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	N/A
BENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
CHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	N/A	N/A
CADMIUM	N/A	N/A	N/A	N/A	N/A	N/A
ALPNA-HCH	N/A	N/A	N/A	N/A	N/A	N/A
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	0.3	0.26	1.4	0.00017	0.3419	0.4825

ADULT	SPLIT MARSH SED 2	SURF SOIL	SPLIT SURF SOIL	SURF DUST	SW-7	SD-2
MANGANESE	N/A	N/A	N/A	0.013	0.063	0.019
BERYLLIUM	0.00025	0.00015	0.00015	N/A	N/A	0.00018
ARSENIC	0.024	N/A	0.016	N/A	N/A	0.017
CHROMIUM	0.013	0.057	0.057	0.09	N/A	N/A
VANADIUM	0.013	0.01	0.01	N/A	N/A	N/A
ALUMINUM	0.012	N/A	N/A	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	N/A
BENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
CHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	N/A	N/A
CADMIUM	N/A	N/A	N/A	N/A	N/A	N/A
ALPNA-HCH	N/A	N/A	N/A	N/A	N/A	N/A
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	0.06225	0.06715	0.8315	0.103	0.063	0.03618
CHILD						
MANGANESE	N/A	N/A	N/A	0.036	0.025	0.018
BERYLLIUM	0.00025	0.00015	0.00015	N/A	N/A	0.00018
ARSENIC	0.22	N/A	0.15	N/A	N/A	0.16
CHROMIUM	0.12	0.53	0.53	0.26	N/A	N/A
VANADIUM	0.12	0.097	N/A	N/A	N/A	N/A
ALUMINUM	0.11	N/A	N/A	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	N/A	N/A	N/A
1,2-DICHLOROPROPANE	N/A	N/A	N/A	N/A	N/A	N/A
BENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
CHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	N/A	N/A	N/A	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	N/A	N/A
CADMIUM	N/A	N/A	N/A	N/A	N/A	N/A
ALPNA-HCH	N/A	N/A	N/A	N/A	N/A	N/A
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	0.5725	0.6264	0.7764	0.298	0.25	0.3417

TABLE 26 (CONT'D)

SUMMARY OF QUANTITATIVE CANCER RISKS BUSH VALLEY LANDFILL

ADULT	SD-7	SPLIT SD-9	LEACH	MW AREA 1	SPLIT MW REA 1	MW AREA 2
MANGANESE	0.00009	N/A	0.088	4	4	417
BERYLLIUM	0.00004	0.00002	N/A	0.0073	0.0073	0.017
ARSENIC	0.00028	0.031	N/A	0.32	0.48	N/A
CHROMIUM	0.00021	N/A	N/A	0.389	0.389	N/A
VANADIUM	0.00025	0.011	N/A	N/A	N/A	N/A
ALUMINUM	0.00021	N/A	N/A	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A	0	0	0
1,2-DICHLOROETHENE	N/A	N/A	N/A	0.018	0.015	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	0.94	0.094	0.16
1,2-DICHLOROPROPANE	N/A	N/A	N/A	0.33	0.33	N/A
BENZENE	N/A	N/A	N/A	0.14	0.14	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	0.49	0.49	N/A
CHLOROBENZENE	N/A	N/A	N/A	0.058	0.058	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	0.00058	0.00058	N/A
TRICHLOROETHENE	N/A	N/A	N/A	0.51	0.51	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	0.011	N/A
CADMIUM	N/A	N/A	N/A	N/A	0.33	N/A
ALPNA-HCH	N/A	N/A	N/A	N/A	N/A	0
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	0.001344	0.04212	0.088	15.90125	17.38225	41.877
CHILD						
MANGANESE	0.0036	N/A	0.27	33.1	33.1	95.2
BERYLLIUM	0.00004	0.0012	N/A	0.017	0.017	0.043
ARSENIC	0.0025	0.29	N/A	0.75	1.1	N/A
CHROMIUM	0.002	N/A	N/A	0.21	0.21	N/A
VANADIUM	0.0024	0.1	N/A	N/A	N/A	N/A
ALUMINUM	0.002	N/A	N/A	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A	0	0	0
1,2-DICHLOROETHENE	N/A	N/A	N/A	0.043	0.043	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A	0	0	0
1,2-DICHLOROPROPANE	N/A	N/A	N/A	0	0	N/A
BENZENE	N/A	N/A	N/A	0	0	N/A
TETRACHLOROETHENE	N/A	N/A	N/A	1.6	1.6	N/A
CHLOROBENZENE	N/A	N/A	N/A	0.029	0.029	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A	0	0	N/A
TRICHLOROETHENE	N/A	N/A	N/A	1.6	1.6	N/A
HEPTACHLOR EPOXIDE	N/A	N/A	N/A	N/A	0.025	N/A
CADMIUM	N/A	N/A	N/A	N/A	0.77	N/A
ALPNA-HCH	N/A	N/A	N/A	N/A	N/A	0
AROCLOR 1254	N/A	N/A	N/A	N/A	N/A	N/A
NICKEL	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	0.01254	0.3912	0.27	37.349	38.495	95.243

ADULT	SB-5	SB-8	WELL GM1US
MANGANESE	N/A	N/A	23.4
BERYLLIUM	0.00027	0.00022	0.0075
ARSENIC	N/A	N/A	N/A
CHROMIUM	N/A	N/A	N/A
VANADIUM	N/A	N/A	N/A
ALUMINUM	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A
1,2-DICHLOROPROPANE	N/A	N/A	N/A
BENZENE	N/A	N/A	0.06
TETRACHLOROETHENE	N/A	N/A	0.32
CHLOROBENZENE	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	0.11
HEPTACHLOR EPOXIDE	N/A	N/A	N/A
CADMIUM	0.0055	0.015	N/A
ALPNA-HCH	N/A	N/A	N/A
AROCLOR 1254	0	0	N/A
NICKEL	N/A	N/A	1.1
TOTAL	0.00577	0.01522	25.0178
CHILD			
MANGANESE	N/A	N/A	55.1
BERYLLIUM	0.00025	0.00021	0.019
ARSENIC	N/A	N/A	N/A
CHROMIUM	N/A	N/A	N/A
VANADIUM	N/A	N/A	N/A
ALUMINUM	N/A	N/A	N/A
VINYL CHLORIDE	N/A	N/A	N/A
1,2-DICHLOROETHENE	N/A	N/A	N/A
1,2-DICHLOROETHANE	N/A	N/A	N/A
1,2-DICHLOROPROPANE	N/A	N/A	N/A
BENZENE	N/A	N/A	0
TETRACHLOROETHENE	N/A	N/A	1.1
CHLOROBENZENE	N/A	N/A	N/A
1,4-DICHLOROBENZENE	N/A	N/A	N/A
TRICHLOROETHENE	N/A	N/A	0.35
HEPTACHLOR EPOXIDE	N/A	N/A	N/A
CADMIUM	0.044	0.12	N/A
ALPNA-HCH	N/A	N/A	N/A
AROCLOR 1254	0	0	N/A
NICKEL	N/A	N/A	2.5
TOTAL	0.0466	0.1221	59.069

TABLE 27 - SEE PAGE 28 OF
DECISION SUMMARY

TABLE 28 - Applicable and/or Relevant Appropriate Requirements (ARARs)
and TBCs for the Bush Valley Landfill Site (Page 1 of 7)

ARAR or TBC	Legal Citation	Classification £n	Summary of Requirement	Applicability to Remedial Alternatives
I. CHEMICAL SPECIFIC				
A. Water				
1. Safe Drinking Water Act	42 U.S.C. §§ 300f et seq.			
a. Maximum Contaminant Levels (MCLs)	40 C.F.R. §§ 141.11-.12 and 141.61 .62	Relevant and Appropriate	MCLs are enforceable standards for public drinking water supply systems which have at least 15 service connections or are used by at least 25 persons. These requirements are not directly applicable since they only apply to delivery at the tap by a public drinking water supplier.	The NCP requires that remedial actions for ground water that is a current or potential source of drinking water shall meet the MCL for each site-related contaminant if the Maximum Contaminant Level Goal ("MCLG") for that contaminant is set at a level of zero and MCLs arc relevant and appropriate under the circumstances of the site. At this Site, MCLs are relevant and appropriate for those substances, pollutants or contaminants that have an MCLCG of zero because the groundwater is a potenlial or current source of drinking water; provided, however, that MCLs are not relevant and appropriate for those inorganics for which the background level exceeds the MCL.
b. Maximum Contaminant Level Goals (MCLGs)	40 C.F.R. §§ 141.50-.51	Relevant and Appropriate	MCLGs are non-enforceable health goals for public water supplies which have at least 15 service connections or are used by at least 25 persons.	The NCP requires that remedial actions for ground water shall meet non-zero MCLs for pollutants, contaminants and hazardous substances, where they ate relevant and appropriate under the circumstances of the site. Non-zero MCLGs are rclcvanl and appropriate for the groundwatcr at this Site because the ground water is a potential o current source of drinking water; provided, however, that MCLGs are not relevant and appropriate for those inorganics for which the background level exceeds the MCLG.

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Unless indicated otherwise under the Classification column, the ARARs and TBCs on this chart are applicable, relevant, and appropriate, or to be considered for Alternatives 2 through 5.

ARAR or TBC	Legal Citation	Classification	Summary of Requirement	Applicability to Remedial Alternatives
2. Clean Water Act: Federal Ambient Water Quality Criteria for the Protection of Aquatic Life	33 U.S.C § 1314	Relevant and Appropriate	These are non-enforceable guidelines established pursuant to Section 304 of the Clean Water Act that set the concentrations of pollutants which are considered adequate to protect aquatic life. Federal antblent water quality criteria may be relevant and appropriate to CERCLA cleanups based on the uses of a water body.	The wetlands adjacent to the Site and the unnamed tributary to the east of the Site are designated for protection of aquatic life. These criteria are relevant and appropriatc to the wetlands and the tributary.
3. Maryland Water Quality Criteria:		Applicable/ Relevant and Appropriate	These are criteria to maintain surface water quality.	The wetlands adjacent to the Site and the unnamed tributary to the east of the Site are surface waters of the State of Maryland and are desiguated for Use I under COMAR 26.08.02. Therefore, these criteria are applicable to any discharge to these surface waters. In the absence of a discharge, they are relevant and appropriate to the wetlands, and must be met.
Surface Water Quality Criteria	COMAR 26.08.02.03			
Toxic Substance Water Quality Criteria	COMAR 26.08.02.03-1			
Numerical Criteria for Toxic Substances in Surface Waters	COMAR 26.08.02.03-2			
Water Quality Criteria Specific to Designated Use/Criteria for Use I Waters	COMAR 26.08.02.03-3 A			
II. LOCATION SPECIFIC				
A. Wetlands				
I. Maryland Wetlands Regulations				
a. Tidal Wetlands	COMAR 08.05.05	Applicable	Provides criteria for any dredging, filling, construction or reconstruction activities in a tidal wetland.	There are tidal wetlands immediately east of the landfill. Any remedial activities that involve coustructiou, reconstruction, dredging, or filling in these wetlands must comply with the substantive standards of these regulations.

ARAR or TBC	Legal Citation	Classification	Summary of Requirement	Applicability to Remedial Alternatives
b. National Wetlands	COMAR 08.05.04	Applicable	Provides criteria for the following activities if undertaken in a nontidal wetland or their buffer zone: (i) removal, excavation or dredging of any materials, (ii) changing existing drainage characteristics, sedimentation patterns, flow patterns, or flood retention characteristics, (iii) disturbance of the water level or water table by drainage, impoundment or other means, (iv) dumping, discharging of, or filling with material, or placing of obstructions, (v) grading or removal of material that would alter existing topography, or (vi) destruction or removal of plant life that would alter the character of a nontidal wetland.	There are nontidal wetlands immediately north of the landfill. Any remedial activities in these wetlands or their buffer zone that involve the following must comply with the substantive standards of these regulations: (i) removal, excavation or dredging of any materials, (ii) challging existing drainage characteristics, sedimentation patterns, flow patterns, or flood retention characteristics, (iii) disturbance of the water level or water table by drainage, impoundment or other means, (iv) dumping, discharging of, or filling with material, or placing of obstructions, (v) grading or removal of material that would alter existing topography, or (vi) destruction or removal of plant life that would alter the character of a nontidal wetland.
2. Federal Regulation of Activities in or Affecting Wetlands	40 C.FR Section 6.302(a)	Applicable	No activity that adversely affects a wetland shall be permitted if a practicable alternative that has less effect is available.	The substantive standards of this regulation are applicable to any remedial activities that could affect the wetlands adjacent to the Site.
3. Federal regulation of activities in or affecting floodplains	40 C.F.R Section 6.302(b)	Applicable	No activity that adversely affects a floodplain should be permitted if a practicable alternative that has less affect is available. If there is no other practicable alternative, impacts must be mitigated.	The substantive standards of this regulation apply to all activities at the Site, because the Site is in a floodplain. These substantive standards would also apply to any discharge to the wetlands or the unnamed tributary east of the Site, since these surface: waters are also in a floodplain.

ARAR or TBC	Legal Citation	Classification	Summary of Requirement	Applicability to Remedial Alternatives
III. ACTION SPECIFIC				
A. Noise				
I. Control of Noise Pollution	COMARs 26.02.03.03 A, B(2), and D(2) and (3)	Applicable	Provides limits on noise levels for the protection of human health and welfare and exemptions in those limits, and specifies standards to be met by sound level meters to be used to determine compliance.	Substantive standards of these regulations shall be met at the landfill property boundaries during construction and operation of the remedy, unless the activity in question is subject to an exemption under COMAR 26 02.03.03 B(2).
B. Water				
1. Regulation of Water Supply, Sewage Disposal, and Solid Waste	COMAR 26.04.04.02 COMAR 26.04.04.07 COMAR 26.04.04.11	Applicable	Establishes requirements for well construction and abandonment.	All wells shall be constructed in accordance with the substantive requirements of COMAR 26.0404.07. Any abandonmenl of wells shall be done in accordance wilh the substantive requiremenls of COMAR 26.04.04.11.
2. Stormwater Management	COMAR 26.09.02.02 COMAR 26.09.02.05 A and B COMAR 26.09.02.06 A(2) COMAR 26.09.02.08	Relevant and Appropriate	Contain minimum rcquirements for the control of stormwater, to be included in ordinances to be adopted by local government bodies.	The substantive requirements are relevant and appropriate in the remedial activities at the Site, unless such activity would be exempled under COMAR 26.09.02.05 B.
3. Erosion and Sediment Control	COMAR 26.09.01.01, COMAR 26.09.01.05 A and B COMAR 26.09.01.07 B COMAR 26.09.01.08 A and B	Relevant and Appropriate	Requires preparation of an erosion and sediment in control plan for activities involving land clearing, grading, and other earth disturbances, and establishes erosion and sediment control criteria.	The substantive standards of these regulations shall apply to clearing, grading, and excavatiou activities at the Site.

ARAR or TBC	Legal Citation	Classification	Summary of Requirement	Applicability to Remedial Alternatives
4. Controls on Discharges	COMAR 26.08.02.04 COMAR 26.08.03.01 COMAR 26.08.03.07 COMAR 26.08.04.01 B COMAR 26.08.04.02 COMAR 26.08.04.02-1 A COMAR 26.08.04.02-1 D	Applicable to Alternatives 4a and 4b	Contains requirements to be met for discharges to surface water, including monitoring requirements.	Alternatives 4a and 4b both include direct discharges to surface waters of the State: 4a to either the wetlands or the unnamed tributary cast of the Site and 4b to the wetlands. The substantive standards of these requirements, including monitoring requirements, would be applicable to auy such discharge. However, no permit would be required. As provided in Section I.A.3 of this Table, the substantive Maryland water quality criteria listed under chemical specific ARARs are also applicable to these discharges.
5. Water Appropriation and Use	COMAR 08.05.02.01 COMAR 08.05.02.03 COMAR 08.05.02.05 COMAR 08.05.02.06	Applicable to Alternatives 4a and 4b	Establishes criteria and terms for persons appropriating or using water.	The substantive standards of these regulations would apply to any appropriation of ground water necessary to implement Alternatives 4a and 4b.
C. Air				
1. Maryland Regulations Governing Air Quality (Volatile Organic Compounds)	COMAR 26.11.06.01 COMAR 26.11.06.06	Applicable	Provides air quality standards, general emission standards and restrictions for air emissions from articles, machine, equipment, etc. capable of generating, causing, or reducing emissions.	The landfill gas vents shall meet substantive standards of these regulations. If any other equipment or construction capable of generating, causing or reducing emissions were required (e.g., an air stripper), it would also have to meet substantive requirements.
2. Maryland Regulations Governing Air Quality (Visible Emissions, Particulates, Nuisance, Odors)	COMAR 26.11.06.01 COMAR 26.11.06.02 COMAR 26.11.06.03 COMAR 26.11.06.08 COMAR 26.11.06.09	Applicable	Provides air quality standards, general emission standards and restrictions for air emissions from articles, machine, equipment, etc. capable of generating, causing, or reducing emissions.	The landfill gas vents shall meet substantive standards of these regulations. If any other equipment or construction capable of generating, causing or reducing emissions were required (e.g, an air strippcr), it would also have to meet substantive requirements.

ARAR or TBC	Legal Citation	Classification	Summary of Requirement	Applicability to Remedial Alternatives
3. Major Source Controls	COMAR 26.11.19.01 COMAR 26.11.19.02 C.	Applicable	Requires reasonably available control technology (RACT) for Control of emissions from existing sources that have the potential to emit more than 25 tons of VOCs per year in specific areas, including Harford County.	The substantive standards of these regulations shall be met if total potential VOCs emissions from the landfill exceed 2.5 tons pet year..
4. Maryland Regulations Governing Toxic Air Pollutants	COMAR 26.11.15	Applicable	Requires emissions of Toxic Air Pollutants ("TAPs") from new and existing Sources to be quantified; establishes mnbient air quality standards and emission limitations for TAP emissions from new sources; requires best available control technology for toxics for new sources of TAPs.	The landfill gas vents shall meet the substantive standards of these requirements. If any other source wcre operated as part of a remedial action (e.g. an air stripper), it would also have to meet the substantive standards of these requirements.
5. Control of Air Emissions from Air Strippers at Superfund Ground- water Sites	OSWER Directive 9355.0-28, June 15, 1989	To Be Considered	This policy guides the decision of whether additional controls (beyond these required by statute or regulation) are needed for air strippers at ground-water sites.	If an air stripper were required, this policy would be considered in determining the necessary emission controls. Sources most in need of additional controls are those with emissions rates in excess of 3 lbs/hour or a potential rate of 10 tons/year of total VOCs.
D. Solid Waste				
1. Sanitary Landfill Closure	COMAR 26.04.07.21 A, 13, D, and E	Applicable	Establishes minimum requirements for closure of municipal landfills including minimum cap specifications.	The specifications of the landfill cap shall, at a minimum, comply with the substantive standards of these requirements.
2. Sanitary Landfills - Post-Closure Monitoring and Maintenence	COMAR 26.04 07.22 A, B, and C	Applicable	Establish minimum post-closure monitoring and maintenance requirements for sanitary landfills.	Post-closure monitoring and maintenance of the landfill shall comply with the substantive standards of these requirements.

ARAR or TBC	Legal Citation	Classification	Summary of Requirement	Applicability to Remedial Alternatives
E. Hazardous Waste				
I. Hazardous Waste Management System and Identification and Listing of Hazardous Waste	COMAR 26.13.01.03 COMAR 26.13.01.05 COMAR 26.13.02	Applicable	Provides definitions for when hazardous waste management requirements are triggered. Contains criteria and lists for identifying characteristic and listed wastes.	These criteria and definitions shall be used in determining whether or not investigation-derived waste to be stored temporarily onsite are to be handled as hazardous waste.
2. Accumulation Limit	COMAR 26.13.03.01 B(1) and (6) COMAR 26.13.03.05 E	Applicable	Provides requirements for persons who treat, store or dispose of hazardous waste onsite.	Investigation-derived wastes that are hazardous waste pursuant to COMAR 26.13.02 and are to be shipped offsite shall be managed (while onsite) in accordance with the substantive standards in COMAR 26.13.03.05 E
3. Monitoring Requirements	40 C.FR. Part 264, Subpart F	Relevant and Appropriate	Includes requirements for groundwater monitoring	The substantive standards for groundwater monitoring containted in these regulations are relevant and appropriate to the groundwater monitoring program included in Alternatives 2 through 5.

TABLE 29 - SEE PAGE 44 OF
DECISION SUMMARY